PB-226 588

POLLUTION OF INTERSTARE WATERS OF THE BLACKSTONE AND TEN MILE RIVERS, MASSACHUSETTS - RHODE ISLAND

Kenneth M. Mackenthun, et al

Robert A. Taft Sanitary Engineering Center
Cincinnati, Ohio

January 1965

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REPORT ON
POLLUTION OF INTERSTATE WATERS OF THE BLACKSTONE AND TEN MILE RIVERS
MASSACHUSETTS - RHODE ISLAND

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January 1965

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SUMMARY AND CONCLUSIONS

1. On the basis of reports, surveys, or studies, having reason to believe that pollution from sources in Massachusetts and Rhode Island was endangering the health or welfare of persons in Rhode Island and Massachusetts, and in accordance with Section 8 of the Federal Water Pollution Control Act, the Secretary of Health, Education, and Welfare called a conference of the State and interstate water pollution control agencies and the Department of Health, Education, and Welfare in the matter of pollution of the interstate waters of the Blackstone and Ten Mile rivers and their tributaries.

2. The Blackstone River begins in the southern part of Worcester, Massachusetts, and flows in a southeasterly direction for 42 miles to Pawtucket, Rhode Island, then southerly for 7 miles to its mouth at the Seekonk River. Principal tributaries include the Mumford and West rivers from Massachusetts, and the Branch River from Rhode Island.

The Ten Mile River begins in Plainville, Massachusetts, and follows an irregular, but generally southerly, course for a distance of 21 miles where it, too, joins the Seekonk River in Rhode Island.

3. Although the Blackstone River and the Ten Mile River in the region of the Massachusetts-Rhode Island State line are considered Class D on the basis of present water quality, both have been assigned a Class C for future highest use by the New England Interstate Water Pollution Control Commission. (See Table 42 for NEIWPCC Classification and Standards of Water Quality.)

4. Although fishing is presently severely limited by pollution, a suitable warm water fish population would develop in both the Blackstone and Ten Mile rivers if pollution did not exist.

5. Raw and partially treated sewage, discharged to the Blackstone River within the 40-mile surveyed reach, from the U. S. Highway 20 bridge in Worcester, Massachusetts, to the Broad St. bridge at the northern limits of Central Falls, Rhode Island, contained 141,000 bacterial population equivalents (BPE) of coliform bacteria. Sixty-seven (67) percent of the bacterial pollution originated in Massachusetts and 33 percent in Rhode Island.

Of the total sewage discharged within the surveyed reach, 90,000 BPE or 64 percent came from Worcester, Mass., 45,000 BPE, or 32 percent, came from Woonsocket, Rhode Island, and 6,000 BPE or 4 percent came from the other 10 smaller jurisdictions located along the river.

Although Worcester sewage received secondary treatment, the effluent was not chlorinated and the plant capacity was inadequate to abate stream pollution. Woonsocket raw sewage was bypassed directly to the river during August while construction of additional treatment units and new chlorination facilities were nearing completion.

Raw and treated sewage, discharged to Ten Mile River, contained 2,400 BPE of coliform bacteria, of which more than 99 percent originated in Massachusetts. Of this total, 2,100 BPE or 88 percent came from Attleboro, Massachusetts, and 300 BPE or 12 percent was included in domestic sewage from industrial plants.

The North Attleboro secondary sewage treatment plant effluent was chlorinated to achieve more than 99.9 percent bacterial removal. Construction of additional treatment facilities and new chlorination facilities at the Attleboro sewage plant was nearing completion in August. Partial treatment by the existing Attleboro sewage plant removed only 88 percent of the bacteria and was not adequate to abate bacterial pollution of Ten Mile River.

6. The Blackstone River was polluted by the oxygen-demanding constituents of sewage and industrial wastes. Forty-two (42) percent of the 219,000 population equivalent total was included in raw and treated municipal sewage and 58 percent in industrial wastes discharged to the river. Forty-two percent of the total oxygen demand from sewage and industrial wastes originated in Massachusetts and 58 percent in Rhode Island.

Woonsocket, Rhode Island, and Worcester, Massachusetts, were almost equally responsible for most of the oxygen demand load contained in sewage: 45,000 population equivalent (PE) or 48 percent came from Woonsocket; 40,000 PE or 43 percent came from Worcester; and 8,000 PE or 9 percent came from the other 10 jurisdictions listed in this report.

Forty-six (46) percent of the oxygen demand in the 126,000 population equivalent total industrial waste load was discharged by

Woonsocket industries. The Branch River Wool Combing Company, discharging 14 percent of the total, was the largest single industrial source of oxygen demand.

Approximately 38 percent of the total industrial waste load was discharged by the following 9 industries:

Hayward Schuster Woolen Mills	10%
Felters Company	8%
Hayward Woolens	5%
Stanley Woolen Mills	4%
Emile Bernat Company	3%
Manville Industries	3%
J. J. O'Donnell Woolens	2%
Stamina Mills	2%
W & S Laundry	1%

Six other industries listed in this report, discharging from 0.2 percent to 0.6 percent each, contributed approximately 2.0 percent of the load.

Eighty-three (83) percent of the 38,000 PE oxygen demand entering Ten Mile River was included in industrial wastes and 17 percent in sewage. More than half (58%) of the total combined industrial and municipal demand came from Thompson Chemical Company, 15 percent from Attleboro Dyeing and Finishing Company, 14 percent from Attleboro sewage, 6 percent from Dodgeville Finishing Company, 5 percent from Pawtucket Dyeing and Finishing Company, and 2 percent from North Attleboro sewage. Ninety-five (95) percent of this demand originated in Massachusetts and 5 percent in Rhode Island.

7. Bacteria in the raw and partially treated sewage, from both Massachusetts and Rhode Island, polluted the Blackstone River and endangered the health of all persons who might contact the river waters throughout the entire 40-mile reach covered by the August 1964 survey. The total coliform objectives for water contact sports and general recreational use were exceeded at every sampling station from Worcester, Massachusetts, to Central Falls, Rhode Island.

Local waters below Worcester contained 8.5 million MPN of total coliform per 100 ml, and those below Woonsocket contained 7.5 million per 100 ml. At these two locations the river contained more than one-third as many total coliform bacteria as can be expected in raw municipal sewage.

The interstate waters, flowing across the State line from Massachusetts into Rhode Island contained a median MPN of 51,500 total coliform bacteria per 100 ml and exceeded the 5,000 general recreation limiting objective by 10 times and the 1,000 Rhode Island water contact sport limiting objective by 50 times.

Sewage-associated bacteria polluted the interstate waters of Ten Mile River and presented a serious hazard to persons, especially children who may come in contact with the river while playing and wading in the river. Sewage discharges, primarily the unchlorinated effluent from the Attleboro sewage treatment plant in Massachusetts, increased the total coliform density to 7.5 million MPN per 100 ml at the State line. This astronomical coliform density was 1,500 times the general recreation objective, 7,500 times the water contact use objective and more than one-third the average coliform density of raw sewage.

8. A study of bottom organisms of the Blackstone River showed stream degradation from wastes originating in Worcester, Massachusetts, and with additional waste contributions in downstream reaches, the polluted bottom conditions extended through Woonsocket, Rhode Island. The Blackstone River receives polluted water from the Mumford River in Massachusetts, and in the region of the State line, from the Branch River in Rhode Island. Pollution from Woonsocket further degraded the stream below this point.

Ten Mile River was severely degraded by pollution from below Whiting Pond in North Attleboro, Massachusetts, to the point where it joins the Seekonk River in East Providence, Rhode Island. At the Massachusetts-Rhode Island State line, sludge deposits and slime growths were evident, and aquatic animal life was limited to those tolerant organisms that could withstand a polluted environment.

Presently, all fishery pursuits are severely limited by pollution on both the Blackstone and Ten Mile Rivers. A few fish are taken, mostly carp and suckers.

9. When the dissolved oxygen (DO) of a river is reduced below an adequate level, fish and the aquatic life on which fish feed are killed or driven out of the area. Both Massachusetts and Rhode Island have

adopted 5 milligrams per liter (mg/l) of DO as one of the minimum water quality standards to maintain a suitable habitat for fishes indigenous to the region (Class C waters).

The oxygen demand of sewage and industrial wastes from Massachusetts and Rhode Island at times removed practically all dissolved oxygen from local reaches of the Blackstone River.

Wastes from the Branch River Wool Combing Company in Rhode Island in combination with the BOD residual from Massachusetts polluted the interstate waters of the Blackstone River and reduced its dissolved oxygen content below the objective for fish and aquatic life as it crossed the second State line into the Massachusetts loop at Blackstone, Massachusetts. At Bridge Street in Blackstone, Massachusetts, the DO averaged 3.5 mg/l, the minimum was 2.3, and 70 percent of all samples collected contained less than the 5.0 mg/l objective.

The oxygen demand of sewage and industrial wastes entering the river in Massachusetts polluted and, at times, removed all dissolved oxygen from the interstate reach of Ten Mile River flowing across the State lines and into Rhode Island. Water quality was degraded below the minimum requirements for fish and other desirable aquatic life by wastes from the Dodgeville Finishing Company, Thompson Chemical Company, Attleboro Dyeing and Finishing Company, an unidentified intermediate source, and the effluent from the Attleboro sewage treatment plant, all in Massachusetts, and the Pawtucket Dyeing and Bleaching Company, in Rhode Island.

10. Floating and suspended slimes, wool fibers, foam, greases, and other obnoxious refuse from sewage and industrial waste discharges in Massachusetts and Rhode Island were responsible for the offensive appearance of local and interstate reaches of the Blackstone and Ten Mile rivers.

11. Sewage and industrial wastes discharged to the interstate waters of the Blackstone and Ten Mile rivers and their tributaries in Massachusetts cause pollution that endangers the health or welfare of persons in Rhode Island; and industrial wastes discharged to the Branch River in Rhode Island and industrial wastes originating in Rhode Island and discharged to the Ten Mile River in Massachusetts cause pollution that endangers health or welfare of persons in Massachusetts, and therefore are subject to abatement under the provisions of the Federal Water Pollution Control Act, as amended (33 U.S.C. 466 et seq).

INTRODUCTION

On the basis of reports, surveys, or studies, having reason to believe that pollution from sources in Massachusetts and Rhode Island was endangering the health or welfare of persons in Rhode Island and Massachusetts, and in accordance with Section 8 of the Federal Water Pollution Control Act, the Secretary of Health, Education, and Welfare called a conference of the State and interstate water pollution control agencies and the Department of Health, Education, and Welfare in the matter of pollution of the interstate waters of the Blackstone and Ten Mile rivers and their tributaries.

This report on pollution of the interstate waters of the Blackstone and Ten Mile rivers is based on: previous reports; data and other materials obtained from the Massachusetts Department of Public Health, the Rhode Island Department of Health, the New England Interstate Water Pollution Control Commission, and the U. S. Geological Survey; information furnished by other interested Federal, State and local agencies and individuals; official records of the Public Health Service; and data obtained by the Public Health Service through field studies conducted during March and August, 1964. Woonsocket, Rhode Island, furnished a site and utility service for the mobile laboratories at their municipal water works.

THE AREA

The Blackstone River (Figure 1*) begins at the American Steel and Wire Company Dam in the Southern part of Worcester, Massachusetts. Above this point for a distance of 3.3 miles, it is known as the Middle River, which receives tributaries from the north, east, and south. The Blackstone River flows in a southeasterly direction for 42 miles to Pawtucket, Rhode Island, then southerly for 7 miles to its mouth at the Seekonk River. In its upper 28 miles, the river flows through Massachusetts, receiving the Mumford and West rivers near Uxbridge. It enters Rhode Island for about one mile, receives the Branch River, which is a Rhode Island tributary, and loops back into Massachusetts. After another short loop of less than a mile, the Blackstone returns to Rhode Island at Woonsocket, Rhode Island. The lower 21 miles flows through Rhode Island.

The Blackstone River drains an area of 540 square miles; its fall averages about 10 feet per mile. Formerly it tumbled over many rocky rapids. Today these have long been buried beneath impoundments to create power. The first use of the water power of the Blackstone

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* Sampling Station Identifications (Table 1), Blackstone River Sampling Locations (Figure A), and Ten Mile River Sampling Locations (Figure B) are included in the Appendix.

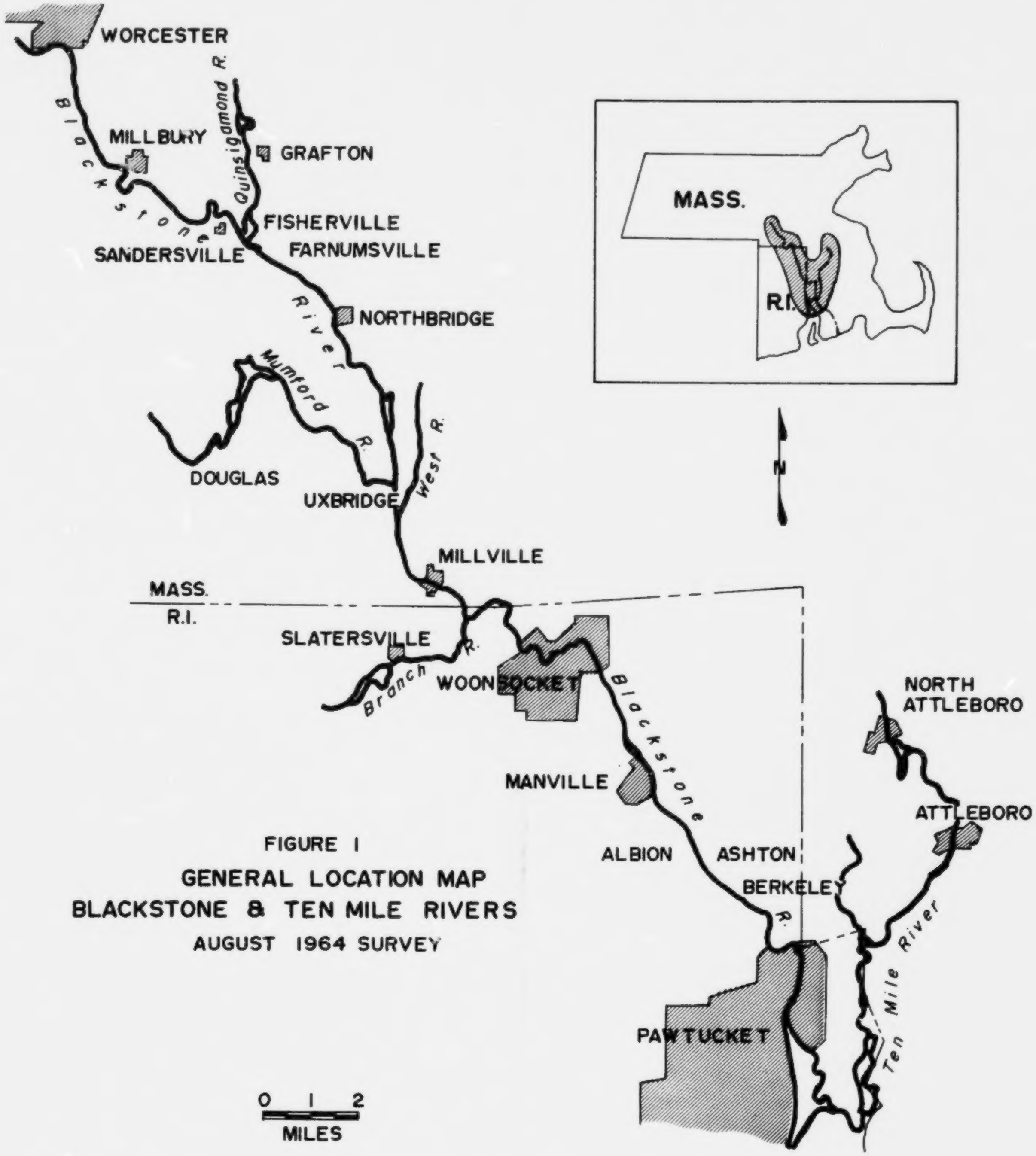

WORCESTER
Blackstone River
Quinsigamond R.
MILLBURY
GRAFTON
FISHERVILLE
SANDERSVILLE
FARNUMSVILLE
NORTHBRIDGE
Mumford R.
West R.
DOUGLAS
UXBRIDGE
MILLVILLE
MASS.
R.I.
SLATERSVILLE
Branch R.
WOONSOCKET
Blackstone R.
MANVILLE
ALBION
ASHTON
BERKELEY
PAWTUCKET
NORTH ATTLEBORO
ATTLEBORO
Ten Mile River
MASS.
R.I.
N
0 1 2
MILES

FIGURE 1
GENERAL LOCATION MAP
BLACKSTONE & TEN MILE RIVERS
AUGUST 1964 SURVEY

10a

10a

River took place in 1671 and by the early 1700's many grist and sawmills were furnished power by low head dams in the basin. Some of these dams have been abandoned, but more than 30 still exist.

The area considered by this report includes the main stem of the Blackstone River and portions of its major tributaries: the Branch River, in Rhode Island, and the Mumford River and the West River, in Massachusetts. The Branch River, with a drainage area of 96 square miles, is the largest tributary in the Blackstone River Basin. It receives industrial wastes and sewage from plant employees in Rhode Island and joins the Blackstone River in Rhode Island immediately before the Blackstone returns to Massachusetts for a short distance prior to its re-entry to Rhode Island. The Mumford River flows from the outlet of Manchaug Pond in Sutton, Massachusetts, and flows in a general easterly direction for 13.3 miles to its confluence with the Blackstone River near Uxbridge, Massachusetts. In this distance it receives sewage and industrial wastes from the surrounding area. After flowing southerly for 16 miles, the West River joins the Blackstone River 0.6 mile downstream from the confluence of the Mumford and Blackstone rivers. The West River receives industrial wastes and sewage from plant employees.

Previous reports, some dating back to the early 1900's, have described the Blackstone River as "little more than an open sewer" and one of the most polluted rivers in Massachusetts. Its crystal clear headwaters are impounded by a series of dams, forming reservoirs that furnish the water supply for the city of Worcester. Below Worcester, however, it is the recipient of sanitary wastes, as well as wastes arising from industrial operations, such as: wool scouring, wool dyeing and finishing, pickling liquors, rubber processing, and paper coating.

This report also considers the entire drainage of the Ten Mile River in Massachusetts and Rhode Island. Ten Mile River (Figure 1) begins at the outlet of a pond in the northwest part of Plainville, Massachusetts. It follows an irregular course for a distance of 20.8 miles: first generally southeast 8.3 miles to Attleboro, Massachusetts, and then generally south-southwest 12.5 miles to Rumford, in East Providence, Rhode Island, where it joins the Seekonk River 2.5 miles above its mouth. It first enters Rhode Island near the northeast corner of the State and after about 0.2 of a mile returns to Massachusetts. After another 0.2 of a mile in Massachusetts, it re-enters Rhode Island, and continues to its junction with the Seekonk. It has a fall that averages 11 feet per mile and a drainage area of 54 square miles.

The Ten Mile River at one time was stocked with brook trout at Attleboro, Massachusetts. Currently, however, it is considered too polluted to be stocked with any fish below its headwaters near Plainville, Massachusetts. It receives municipal wastes, as well as plating, pickling, chemical, and textile wastes.

On September 24, 1958, the New England Interstate Water Pollution Control Commission approved the classification recommendations for the Blackstone River as submitted jointly by the States of Massachusetts and Rhode Island. The basis for these recommendations was the "Tentative Plan for Classification of Waters" adopted by the Commission, of which both States are signatory members. This Plan was revised and formally adopted as of October 1, 1959, and the water quality requisites for each classification are described in Table 42.

At the time of classification the condition of the Blackstone River from Fisherville, Massachusetts, to Woonsocket, Rhode Island, was Class D with proposed upgrading to Class C. From Worcester to Fisherville, Massachusetts, and from Woonsocket to Sneech Brook in Rhode Island, the river was designated Class E or nuisance condition (see footnote to Table 42). The proposed highest use classification upgrades the water quality in the upper reach from Worcester to Fisherville to Class D, in the lower reach from Woonsocket to Manville to Class C, and from Manville to Sneech Brook to Class B. From Sneech Brook to tidewater at Pawtucket, the river was rated Class D and called for upgrading to Class B from Sneech Brook to Lonsdale and to Class C below Lonsdale and through Pawtucket.

The uses for which Class D water quality are suitable are ". . . transportation of sewage and industrial wastes without nuisance and for power, navigation, and certain industrial uses."

Class C water quality is described as being " . . . suitable for recreational boating; irrigation of crops not used for consumption without cooking; habitat for wildlife and common food and game fishes indigenous to the region; industrial cooling and most industrial process uses." Among other requirements, Class C waters shall have not less than 5 parts per million of dissolved oxygen. Oil, grease, color, and turbidity shall not be objectionable, and there shall be no odor, scum, floating solids, debris, and sludge deposits. No limiting values have been established for bacterial pollution.

Branch River has been determined to be Class D on the basis of present water quality from Slatersville Reservoir to its confluence with the Blackstone River. It has been assigned a future highest use classification of C in this reach.

Ten Mile River has been determined to be Class D on the basis of present water quality from the North Attleboro, Massachusetts, sewage treatment plant to the East Providence, Rhode Island, water supply reservoir. In June 1956 the New England Interstate Water Pollution Control Commission assigned a highest use classification for this reach of the Ten Mile River as Class C. The classification system of the NEIWPCC is set forth in Table 42.

WATER USES

MUNICIPAL USE

East Providence, Rhode Island, obtains its water supply from the East Providence Reservoir situated on Ten Mile River. The system serves 42,000 consumers. Taste and odor problems have been reported. The Rhode Island Department of Health has recommended that this source be abandoned because of pollution. On June 9, 1964, the residents of East Providence voted in favor of a $7 million bond issue to obtain a safe water supply from the Providence municipal system.

INDUSTRIAL WATER SUPPLY

The Blackstone and Ten Mile rivers provide process water to industry and are used for wooling, water power, and fire protection.

RECREATION

Water-related recreational activities have increased rapidly on a national scale, especially near centers of population. The immeasurable aesthetic values that an unpolluted waterway supplies are very important assets of adjacent metropolitan areas. As indicated below, these considerations have little relevance to the Blackstone and Ten Mile rivers, whose usefulness for recreation has been greatly damaged by pollution caused by domestic and industrial wastes.

Fishing

The Blackstone River once supported a notable run of American shad that was destroyed at an early date by the construction of dams. Presently, all fishery pursuits are severely limited by pollution. The main stem is practically uninhabitable for fish. A few fish, mostly carp and suckers, are taken from the river. When pollution is abated, the Blackstone River will be repopulated naturally by warm water species of fish. At present, because of pollution, there are no plans to develop a fishery. Trout, which are stocked in Lake Quinsigamond during the spring of each year, provide sport fishing for about 30 days after the fish are released. Fisherville Pond near Fisherville, Massachusetts, is also reported to provide fishing.

Ten Mile River is also stocked with about 800 brook trout at Plainville, Massachusetts during the spring of each year. The condition of the water is such that in all probability a game fish population could not be supported. When pollution is abated, there is a distinct probability that warm water species will repopulate naturally without restocking.

In both the Blackstone and Ten Mile rivers, a suitable warm water fish population would develop if gross pollution did not exist.

Seining of golden shiners for bait-fish is carried out on the Blackstone River from Woonsocket to Pawtucket, Rhode Island.

Other Recreational Pursuits

Some canoeing activity is reported on the Blackstone River. However, physical difficulties are present that require many portages.

Lake Quinsigamond and other nearby ponds are used for boating, swimming, water skiing, and other water sports. Where there is suitable water, some of the people who live near the stream, and some who visit the river to enjoy being near water will swim on an unorganized basis. Although no bathing beaches were observed on the main stems, the Blackstone and Ten Mile rivers undoubtedly are no exception to this generalization.

NAVIGATION

The Blackstone River has not been used for navigation since abandonment of the barge canal in 1848.

HYDROPOWER

The Blackstone and Ten Mile rivers have been used for power purposes since shortly after settlement began. Thirteen hydroelectric plants on the Blackstone River use 200 feet of the total fall of 439 feet and have a total installed capacity of 6,500 kilowatts.

SOURCES OF WASTES

The most significant types of wastes in the Blackstone River drainage area are municipal sewage and woolen textile wastes. In the Ten Mile River drainage area, wastes include municipal sewage and woolen textile wastes, chemical process wastes, and metal plating wastes.

With the exception of the chemical and metal plating wastes, the principal pollutional constituents of the wastes may be expressed in terms of 5-day biochemical oxygen demand (BOD), suspended solids, and coliform bacteria. In tables in the Appendix, waste characteristics are presented in population equivalents of these three constituents. One population equivalent is that quantity of the constituent that would be contained in the raw sewage produced by one person in one day. For example, a waste containing one population equivalent each of oxygen-demanding material (BOD), suspended solids, and coliform bacteria would contribute one/sixth pound of 5-day BOD, one/fifth pound of suspended solids and 400 billion coliform bacteria to the receiving waters.

Data on sewage and industrial waste characteristics are presented in Tables 2 through 5 of the Appendix. Much of the data is based on sampling and analyses of the wastes, but in some cases reasonable estimates have been made on the basis of population served by sewers.

BACTERIA

Sewage is the principal source of bacterial pollution in the Blackstone River.

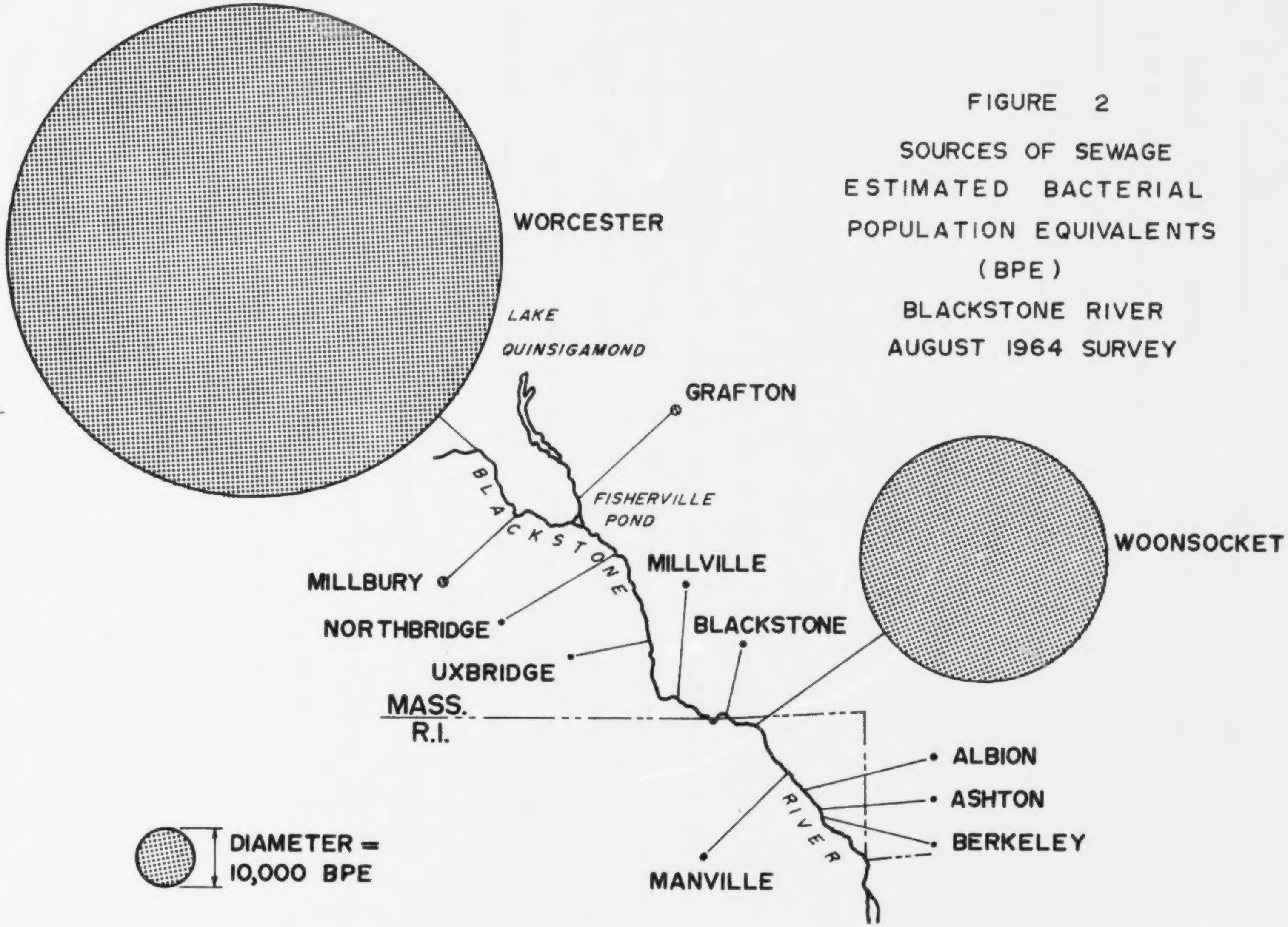
Blackstone River

Table 2 lists the sources and characteristics of municipal sewage discharged to the Blackstone River and tributaries between Worcester, Massachusetts, and Central Falls, Rhode Island. The relative bacterial contributions of the individual sources are shown in Figure 2. Of the 12 jurisdictions listed, 7 are in Massachusetts and 5 are in Rhode Island. Eighty (80) percent of the population served by municipal sewers resides in Massachusetts. The 180,000 sewered population in Worcester represents 76 percent of the total. Twenty (20) percent of the sewered population resides in Rhode Island. Woonsocket, with a 45,000 sewered population, represents 19 percent of the total.

Worcester and Northbridge, Massachusetts, provide secondary sewage treatment. Woonsocket, Rhode Island, discharged raw sewage to the river while rehabilitating and constructing additions to their treatment plant during the August 1964 survey. The other 9 jurisdictions, which have no sewage treatment, discharge raw sewage directly to the river. Four (4) of the 9 have no sanitary sewer systems; the sources being private sewer outlets and connections to private storm drains.

FIGURE 2

SOURCES OF SEWAGE
ESTIMATED BACTERIAL
POPULATION EQUIVALENTS
(BPE)
BLACKSTONE RIVER
AUGUST 1964 SURVEY


WORCESTER
LAKE
QUINSIGAMOND
GRAFTON
FISHERVILLE
POND
BLACKSTONE
MILLBURY
NORTHBRIDGE
MILLVILLE
UXBRIDGE
BLACKSTONE
WOONSOCKET
MASS.
R.I.
ALBION
ASHTON
BERKELEY
RIVER
MANVILLE
DIAMETER =
10,000 BPE

Of the 140,000 total BPE entering the Blackstone River, 67 percent originates in Massachusetts and 33 percent in Rhode Island.

Worcester, Massachusetts, is the single largest source of coliform bacteria. Sanitary sewage from Worcester is treated in an inadequate overloaded secondary treatment plant, which lacks proper sludge digestion facilities and does not provide chlorination for effluent disinfection. The effluent contained approximately 90,000 BPE, which amounted to 64 percent of the total coliform bacterial load entering the Blackstone River.

Woonsocket, Rhode Island, discharging 45,000 BPE in raw sewage, contributes 32 percent of the total. It was the second largest single source of coliform bacteria. All raw sewage from Woonsocket bypassed the treatment plant and entered the river without treatment during the August 1964 survey. Construction of new primary treatment and effluent chlorination facilities and the rehabilitation of existing secondary treatment units were nearing completion during August. When completed, the total 5.0 million gallons per day (mgd) of Woonsocket domestic sewage will receive primary treatment, approximately 3.5 mgd of the primary effluent will receive standard rate activated sludge type secondary treatment, and all effluents will be chlorinated. The pollutional loading, including coliform bacteria, entering this reach of the river should be greatly reduced when the expanded Woonsocket sewage treatment plant is completed and placed in full operation.

Coliform bacteria in the sewage discharges from the other 10 jurisdictions listed in Table 2 amounted to 5,400 BPE, or 4 percent of the total. Individual loads from these 10 jurisdictions ranged from 1,200 BPE (0.9 percent of total) at Millbury to 140 BPE (0.1 percent of total) at Ashton.

Bacterial pollution is discharged from industrial plants, as well as in the sewage from plant employees. Table 4 lists estimated bacterial loads from these sources. The total BPE from all industrial plants is estimated to be 1,750, with 53 percent occurring in Massachusetts and 47 percent in Rhode Island.

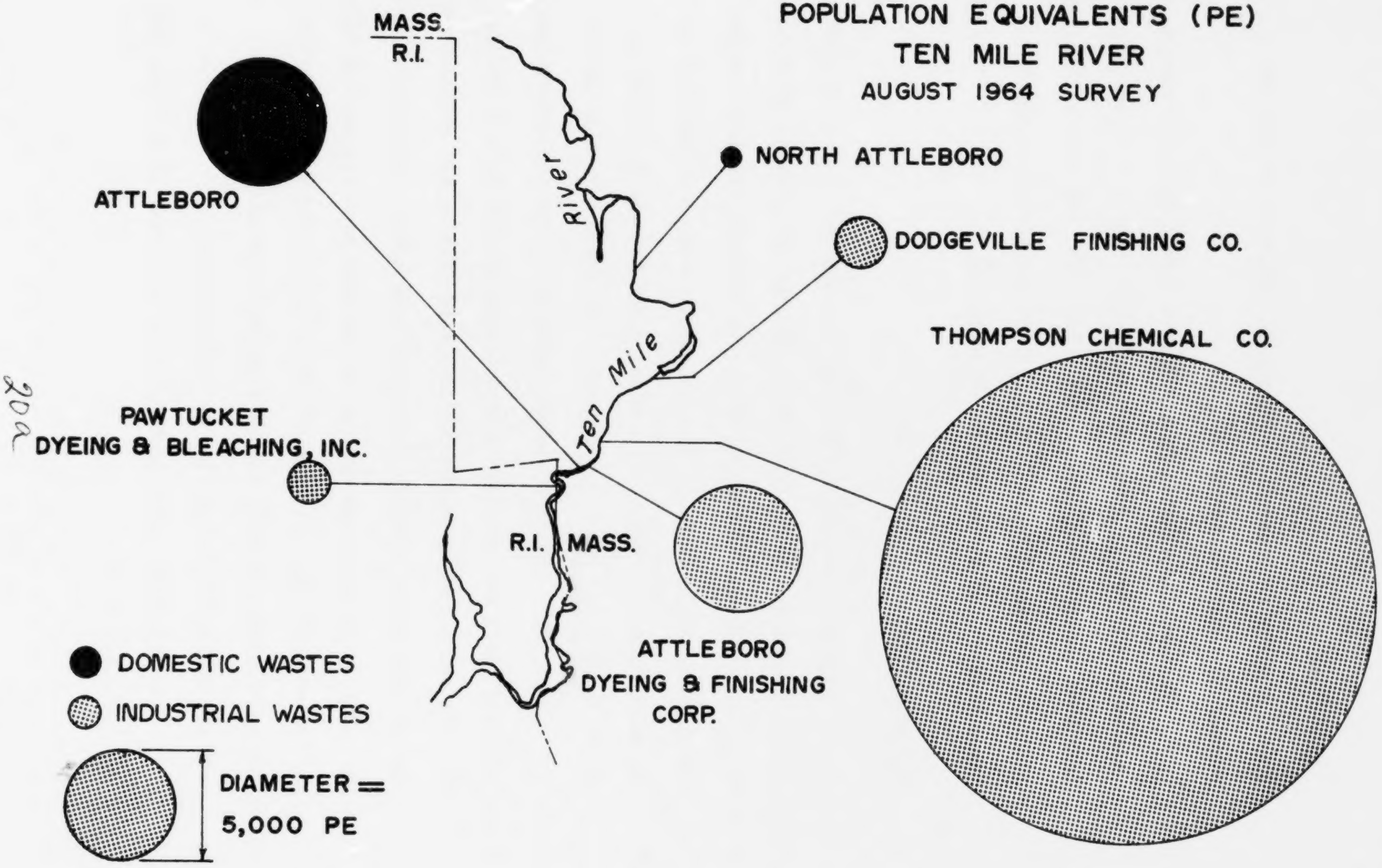
Ten Mile River

Attleboro and North Attleboro are the two sources of municipal sewage discharged to Ten Mile River between Plainville, Massachusetts, and the confluence of the Ten Mile with the Seekonk River in East Providence, Rhode Island. Both of these (Table 3 - Appendix) are in Massachusetts. The total estimated BPE from both sources is 2,105, with 2,100 BPE, or practically 100 percent from Attleboro.

The North Attleboro sewage treatment plant includes primary settling tanks and separate sludge digestion high rate trickling filters and secondary sedimentation, sand filters and effluent chlorination facilities. During the August 1964 survey, effluent from the secondary clarifiers was applied to the slow sand filters and this filter effluent was chlorinated before it entered Ten Mile River. The low coliform density in the final effluent attests to the effectiveness of disinfection by chlorination.

In Attleboro, additional primary treatment facilities, new high rate trickling

FIGURE 3
SOURCES OF SEWAGE & INDUSTRIAL WASTES
ESTIMATED OXYGEN DEMAND
POPULATION EQUIVALENTS (PE)
TEN MILE RIVER
AUGUST 1964 SURVEY


MASS.
R.I.
ATTLEBORO
NORTH ATTLEBORO
DODGEVILLE FINISHING CO.
THOMPSON CHEMICAL CO.
River
Ten Mile
PAWTUCKET DYEING & BLEACHING, INC.
R.I.
MASS.
ATTLEBORO DYEING & FINISHING CORP.
● DOMESTIC WASTES
▨ INDUSTRIAL WASTES
DIAMETER = 5,000 PE

filter secondary treatment units, and chlorination facilities will supplement the original sand filter plant. Construction of these facilities was nearing completion during the August 1964 survey. During much of the survey period, raw sewage was bypassed around the primary units, applied directly on to the sand filters, and the filter effluent entered the river without chlorination. The pollution loading, including coliform bacteria, from this source should be significantly reduced when the new treatment facilities are placed in operation.

The sewage from industrial plant employees (Table 5 - Appendix) contributes a combined bacterial load of 321 BPE. Of this, 95 percent is in Massachusetts, and 5 percent is in Rhode Island.

BIOCHEMICAL OXYGEN DEMAND (BOD)

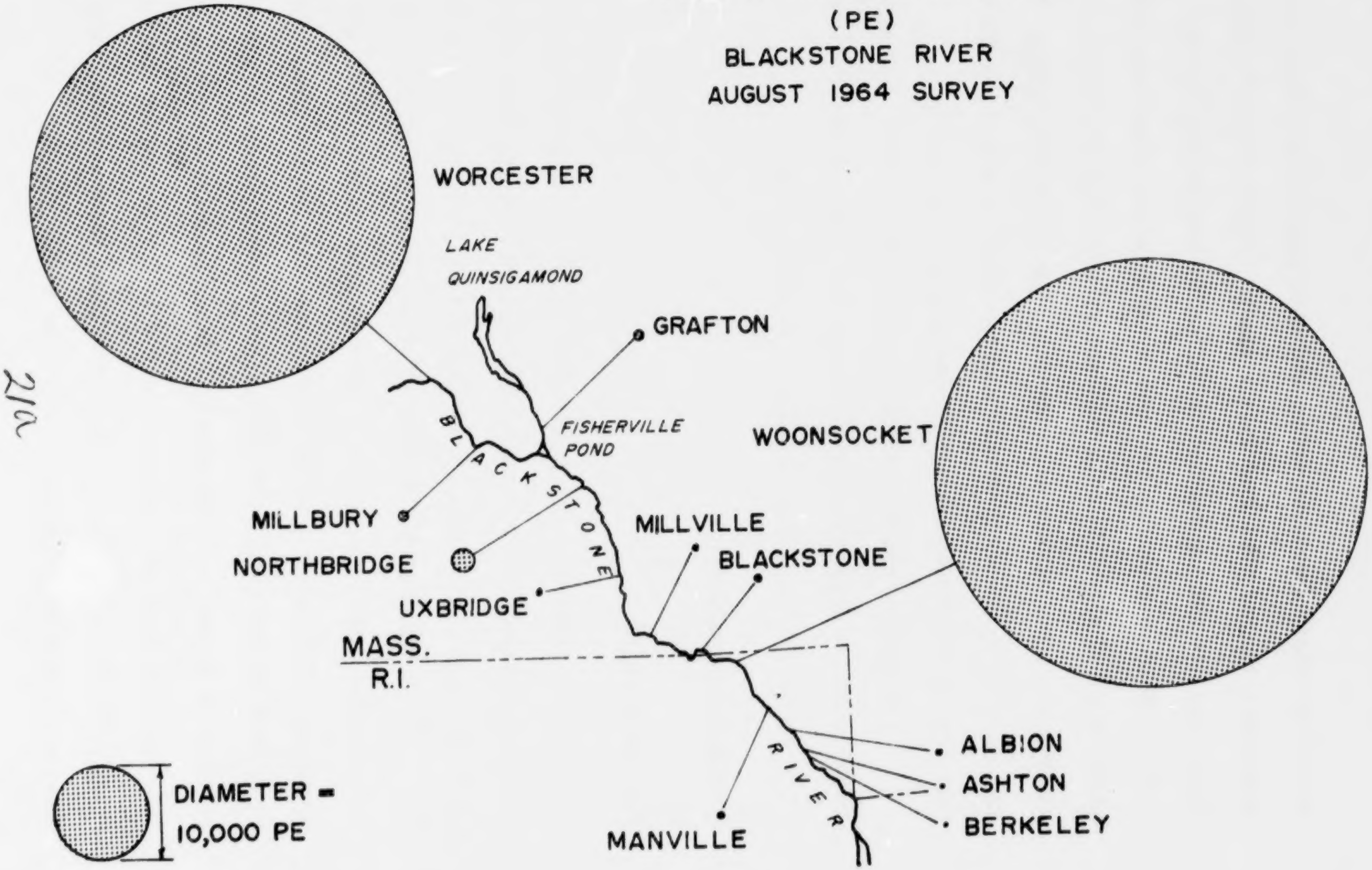
Blackstone River

The estimated oxygen demand population equivalents of municipal sewage discharged to the Blackstone River are given in Table 2 and those of industrial wastes discharging directly to the river in Table 4.

The total from all sources of sewage is 93,000 PE, with 50 percent from Massachusetts and 50 percent from Rhode Island. Raw sewage from Woonsocket (Figure 4) contained the largest load, with 48 percent of the total, and the Worcester sewage treatment plant effluent is second, with 43 percent. Other sources, accounting for the remaining 9 percent, ranged from 0.2 to 2.7 percent of the total each, with the effluent from the Northbridge, Massachusetts, sewage treatment plant being responsible for the higher figure.

FIGURE 4

SOURCES OF SEWAGE
ESTIMATED OXYGEN DEMAND
POPULATION EQUIVALENTS
(PE)
BLACKSTONE RIVER
AUGUST 1964 SURVEY


WORCESTER
LAKE QUINSIGAMOND
GRAFTON
FISHERVILLE POND
BLACKSTONE
WOONSOCKET
MILLBURY
NORTHBRIDGE
UXBRIDGE
MILLVILLE
BLACKSTONE
MASS.
R.I.
RIVER
ALBION
ASHTON
BERKELEY
MANVILLE
DIAMETER = 10,000 PE

The oxygen demand of industrial wastes, listed in Table 4, exceeded that of the sewage discharges that entered the Blackstone River. The total from all sources is 126,000 PE, with 35 percent from Massachusetts and 65 percent from Rhode Island. The heaviest industrial load enters the river at Woonsocket (Figure 5) where 8 of 10 unnamed plants, not served by the municipal sewers, account for 46 percent of the total from all sources. No estimates are available for 2 of the 10. The second heaviest load, 14 percent of the total, reaches the Blackstone through the Branch River from the Branch River Wool Combing Company, Incorporated, in Branch Village, Rhode Island. As noted previously, the Branch River enters the Blackstone in the one mile reach which loops from Massachusetts into Rhode Island and back into Massachusetts. The third and fourth largest sources are the Hayward-Schuster Woolen Mills, Incorporated, on the Mumford River in Massachusetts, with 10 percent of the total, and the Felters Company, in Millbury, Massachusetts, with 8 percent.

Approximately 20 percent of the total load is discharged by the following seven industries:

Hayward Woolens	5% of the total
Stanley Woolen Mills	4% "
Emile Bernat Co.	3% "
Manville Industries	3% "
J. J. O'Donnell Woolens	2% "
Stamina Mills	2% "
W. & S. Laundry	1% "

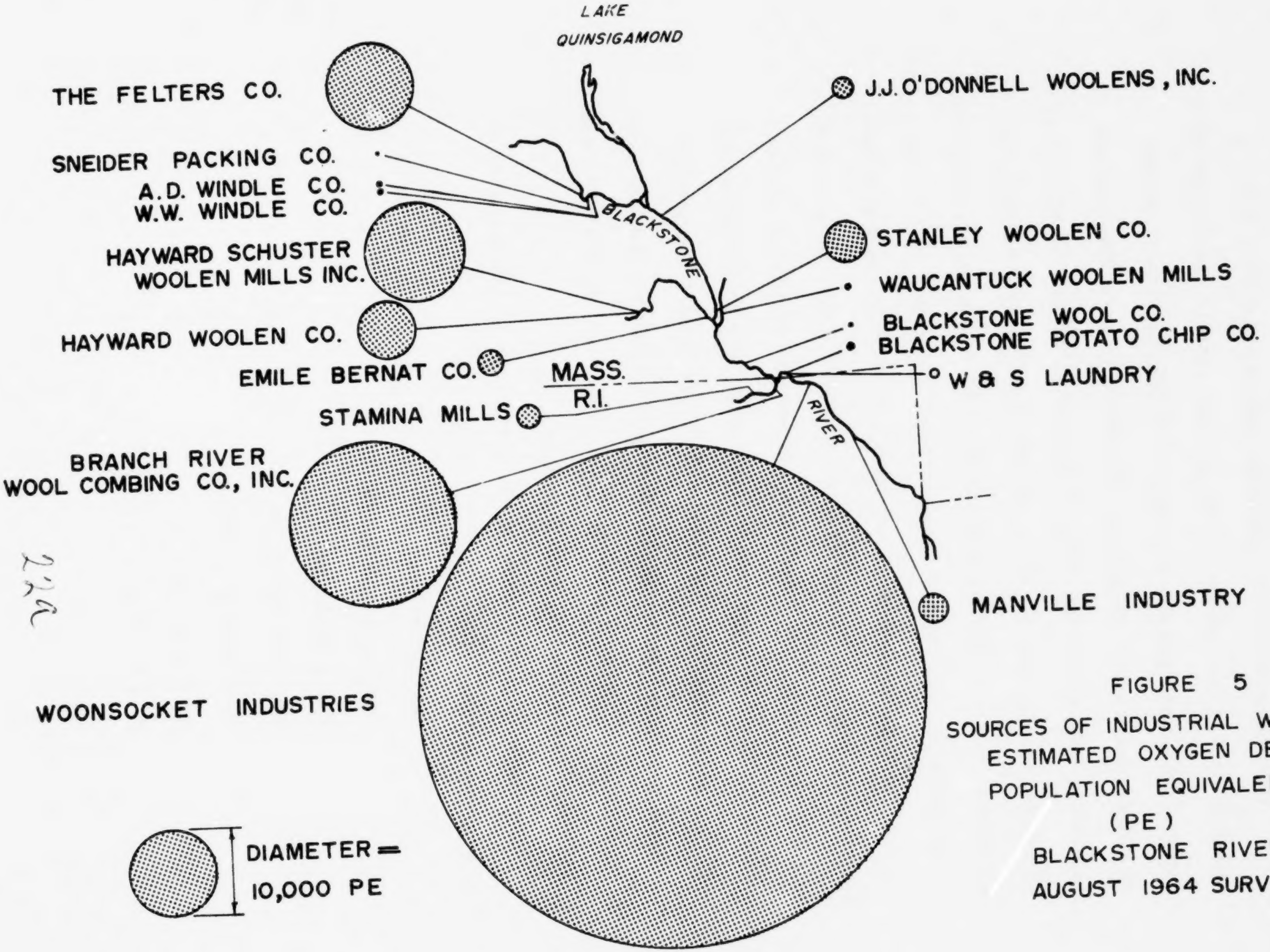

LAKE QUINSIGAMOND
THE FELTERS CO.
SNEIDER PACKING CO.
A.D. WINDLE CO.
W.W. WINDLE CO.
HAYWARD SCHUSTER WOOLEN MILLS INC.
HAYWARD WOOLEN CO.
EMILE BERNAT CO.
STAMINA MILLS
BRANCH RIVER WOOL COMBING CO., INC.
WOONSOCKET INDUSTRIES
DIAMETER = 10,000 PE
J.J. O'DONNELL WOOLENS, INC.
BLACKSTONE
STANLEY WOOLEN CO.
WAUCANTUCK WOOLEN MILLS
BLACKSTONE WOOL CO.
BLACKSTONE POTATO CHIP CO.
MASS.
R.I.
W & S LAUNDRY
RIVER
MANVILLE INDUSTRY

FIGURE 5
SOURCES OF INDUSTRIAL WASTES
ESTIMATED OXYGEN DEMAND
POPULATION EQUIVALENTS
(PE)
BLACKSTONE RIVER
AUGUST 1964 SURVEY

Six other industries, shown in Table 4 and Figure 6, discharging from 0.2 percent to 0.6 percent each, contributed approximately 2 percent of the total industrial waste load.

The total PE from sewage and industrial wastes discharged to the Blackstone River in both Massachusetts and Rhode Island is 219,000. Of this, 42 percent originates in Massachusetts and 58 percent in Rhode Island. Sewage accounts for 42 percent of the total, and industrial wastes for 58 percent.

Ten Mile River

Waste discharges from four industries (Table 5) and the effluent from two municipal sewage treatment plants (Table 3) are responsible for the oxygen-demanding material discharged to Ten Mile River.

As illustrated on Figure 3, more than half of the total load is discharged from the Thompson Chemical Co. The second and third largest loads are contained in the effluent from the Attleboro Dyeing and Finishing Corporation holding ponds (15% of total) and the effluent from the Attleboro sewage treatment plant (14% of total). Dodgeville Finishing Company (6%), Pawtucket Dyeing and Bleaching (5%), and the North Attleboro sewage treatment plant (2%) are responsible for the remaining 13 percent of the total load.

Five of these six sources of oxygen-consuming wastes are located in Massachusetts. The Pawtucket Dyeing and Bleaching plant is physically located in Rhode Island, but the effluent from their industrial waste holding ponds enters the Massachusetts section of a loop in Ten Mile River where the river flows from Rhode Island into Massachusetts and then back again into Rhode Island.

The total PE of sewage and industrial wastes discharged to the Ten Mile River in both Massachusetts and Rhode Island (Figure 3) is 37,800, of which 95.0 percent originates in Massachusetts and 5.0 percent in Rhode Island. Sewage accounts for 17 percent of the total and industrial wastes for 83 percent.

SUSPENDED SOLIDS

Blackstone River

The suspended solids population equivalents (SSPE) of municipal sewage discharged to the Blackstone River are given in Table 2. The total from all sources is 99,000, of which 53 percent originates in Massachusetts and 47 percent in Rhode Island. Worcester is the largest source, with 49 percent of the total, and Woonsocket is second, with 45 percent. The other 10 sources, listed in Table 2, contribute the remaining 6 percent of the total.

Industrial wastes contribute 61,300 SSPE's, with 24 percent discharged in Massachusetts and 76 percent in Rhode Island. Here, again, 8 of the 10 unnamed industries not served by the municipal sewers in Woonsocket discharge approximately one-half of the total, and the Branch River Wool Combing Company, Incorporated, plant is the largest of the individual contributors, with 24 percent of the total.

Hayward-Schuster Woolen Mills, Incorporated, on the Mumford River, is third, with 11 percent of the total. The other 15 plants, shown in Table 4, are responsible for the remaining 16 percent of the total suspended solids loading for the Blackstone River.

The total SSPE of sewage and industrial waste discharged to the Blackstone River in both Massachusetts and Rhode Island is 160,300, of which 42 percent originates in Massachusetts and 58 percent in Rhode Island. Of the total, 62 percent is from sewage and 38 percent is from industrial wastes.

Ten Mile River

The Ten Mile River receives a total SSPE of 6,200 from municipal sewage and industrial wastes (Tables 3 and 5) in Massachusetts and Rhode Island. Ninety (90) percent of this originates in Massachusetts, and 10 percent in Rhode Island. Fifty-one (51) percent is from municipal sewage and 49 percent from industrial wastes.

METAL PLATING WASTES

Numerous metal plating plants are situated in Plainville, North Attleboro, and Attleboro, Massachusetts. Although most of the plants are quite small, in combination they handle large volumes of a variety of highly toxic chemicals. Of these, cyanides of various metals used in plating probably are the most toxic. Metals used include gold, silver, rubidium, chromium, nickel, copper, and zinc. Most of these, even in low concentrations, are toxic to aquatic life. The sudden discharge of even a small tank of cyanide by accident, or by intent to dispose of a spent bath, could wipe out the fish in the small flow of the Ten Mile River for many miles. A more subtle effect might be the accumulative destructive effect on aquatic life of minute quantities of these toxic materials from each of the many plants involved.

Table 6 (Appendix) lists the plating plants situated in the Massachusetts towns along Ten Mile River. Data that would permit an inventory of quantitative waste loads from each of the plants are not available at present.

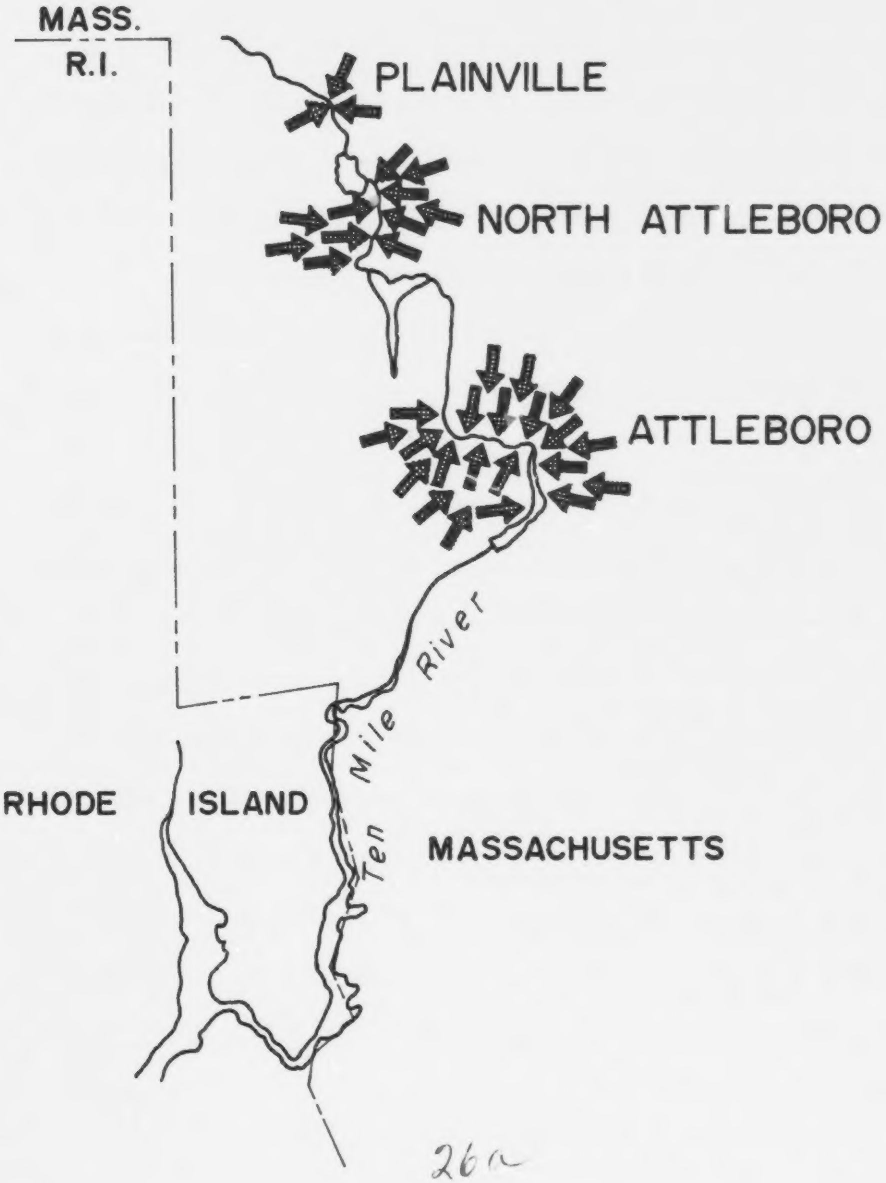
Figure 6 shows the approximate locations of all known plants. There are 3 plants in Plainville, 11 in North Attleboro, and 21 in Attleboro.

COMBINED SEWERS

Worcester and Millbury in Massachusetts, with a total sewered population of 181,000, have combined or both separate and combined sewers. The status of storm water connections was undetermined in three smaller Rhode Island jurisdictions where domestic sewage is collected by old mill sewers. Combined sewers, which are common in older municipalities throughout the country, receive both domestic sewage and storm water.

Large quantities of sewage and storm water enter combined systems during storms. Overflow devices are provided to bypass portions of the mixed storm flows from the system to the nearest watercourse without treatment. Thus, the raw sewage diverted during storms intermittently may cause pollution of the receiving stream even after treatment has been provided for dry weather sewage flow.

FIGURE 6
SOURCES OF PLATING WASTES
TEN MILE RIVER
AUGUST 1964 SURVEY


MASS.
R.I.
PLAINVILLE
NORTH ATTLEBORO
ATTLEBORO
Ten Mile River
RHODE ISLAND
MASSACHUSETTS

26a

EFFECTS OF POLLUTION ON WATER QUALITY AND USES

Excessive bacterial pollution of a stream presents a health hazard to those who come in contact with the water. Excessive suspended solids diminish the beauty of water and settle to and blanket the stream bottom where they form sludge deposits that can produce offensive odors, reduce or eliminate aquatic life on which fish feed, and interfere with fish spawning. Excessive oxygen demand reduces the dissolved oxygen of the water, which results in reduction or destruction of desirable aquatic life, including fish, and may produce offensive odors.

Survey data, indicating the effects of pollution, are tabulated in the Appendix. Bacteriological data, including results of total and fecal coliform determinations, are shown in Tables 7 through 13. Biological data are reported in Tables 14 through 19. Chemical data, including 5-day BOD, D.O., temperature, pH, metals, ABS, nitrogen and sampling times are shown in Tables 20 through 39. River discharges are shown on Tables 40, 41 and 43.

BACTERIAL POLLUTION

Municipal sewage contains enormous numbers of bacteria, among which there are frequently pathogenic bacteria, derived from human excreta, that can cause gastrointestinal diseases such as typhoid fever, dysentery, and diarrhea. Infectious hepatitis, a virus disease, can also be caused by ingesting sewage-polluted water. Eye, ear, nose, throat, or skin infections may result from bodily contact with such waters. As the densities of pathogenic bacteria are reduced by sewage treatment or forces of natural purification, the hazards of contracting disease are proportionately reduced.

Sewage also contains bacteria of the coliform group which typically occur in excreta, or feces, and can readily be detected even at low densities. These bacteria, harmless in themselves, are determined in stream studies involving sewage pollution as indicators of the probable presence of pathogenic bacteria. In the absence of adequate methods for detection of other pathogenic organisms, such as viruses, in rivers, coliform bacteria also serve as indicators of the probable presence of these organisms.

For many years the laboratory method for determination of the coliform group has been a principal tool used by sanitary engineers in evaluating bacterial pollution of surface waters. The coliform group has been used by numerous State and interstate water pollution control agencies as a basis for water quality objectives for various water uses. Unfortunately, the coliform group includes several types of bacteria which may come from sources other than excreta, and coliform data sometimes have been challenged because of this. In the last few years a method for specific detection of fecal coliform bacteria only has been developed. Although the method has the decided advantage of specificity, it has not been in use long enough to serve as a basis for quantitative water quality objectives. Both methods of bacterial measurement were applied to all samples in this study.

The results of both determinations are expressed in terms of most probable numbers, or MPN, per 100 milliliters (ml) of water. One hundred ml is a little less than one-half cup. The coliform group usually is designated as total coliforms.

Neither Massachusetts nor Rhode Island has adopted a total coliform objective of water quality for recreational uses such as boating and fishing. Where such an objective has been adopted the commonly used MPN is 5,000 per 100 milliliters (ml) of water.

Both States have total coliform objectives for Class B waters, used for water contact sports such as swimming and skiing. The Massachusetts limit is a mean of 2,400 per 100 ml, and the Rhode Island MPN limit is a median less than 1,000 per 100 ml with not more than 20 percent of the samples equal to or greater than 2,400 per 100 ml during the bathing season.

The median coliform densities observed during the August 1964 survey are summarized in Table 13 and plotted on Figures 7 and 8. Horizontal lines through the 5,000, 2,400 and 1,000 MPN/100 ml values on the graphs permit comparison of the values found in the Blackstone and Ten Mile rivers with the total coliform water quality objective most commonly used for general aquatic recreation, and for water contact sports in Massachusetts and Rhode Island. River water densities at some locations can be compared with the 20,000,000 MPN/100 ml total coliform density level that can be expected in average raw domestic sewage.

Blackstone River

Raw and partially treated sewage, from both Massachusetts and Rhode Island, polluted the entire 40-mile reach of the Blackstone River included in the August 1964 survey. The total coliform objectives for water contact sports and general recreational use of the river were exceeded at every sampling station from Worcester, Massachusetts to Central Falls, Rhode Island (Figure 7).

The Blackstone River was most severely polluted in the vicinity of McCraken Road Bridge (B-13) about one-half mile below the outfall from the 22 million gallons per day Worcester sewage plant. At this location, sewage plant effluent amounted to almost one-half of the entire 48 million gallons per day (75 cfs) flow in the river,

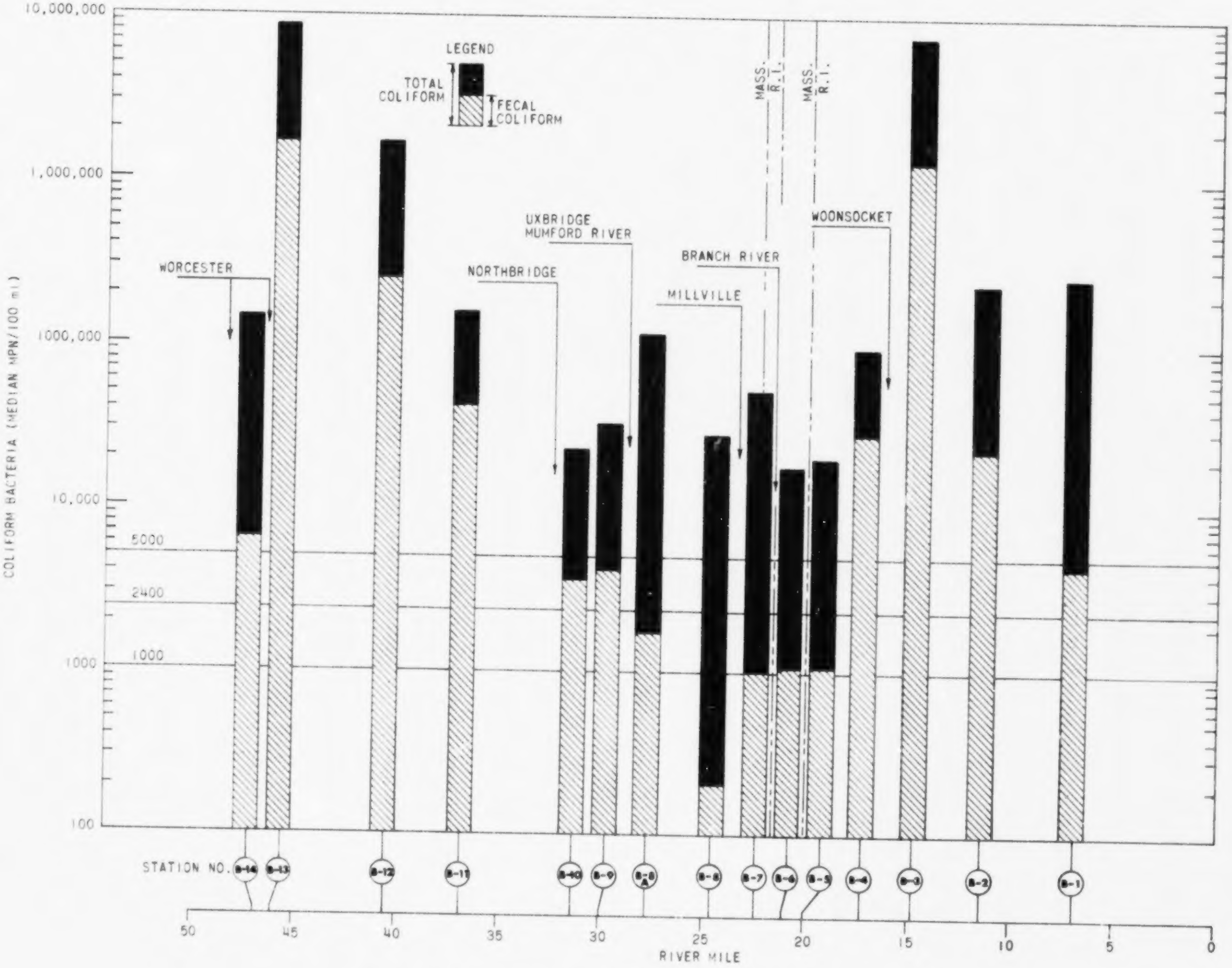


Figure No. 7. TOTAL & FECAL COLIFORM - BLACKSTONE RIVER - AUGUST 1964 and the median total coliform density soared to 8.5 million per 100 ml of river water. Nineteen (19) percent, or 1,650,000, of this total were fecal coliform bacteria.

The observed median density, which was equivalent to about 5,000 coliform bacteria per drop of water, was 1,700 times higher than the objective for general recreational use. The enormity of this bacterial pollution can be visualized by realizing that the average total coliform density of raw sewage (20,000,000 MPN/100 ml) amounts to only slightly more than twice the median density in the river water.

After leaving Worcester, the river flowed through a series of impoundments in the 15-mile distance and 3-1/2 days flow time to the outlet of Rice City Pond. Within this reach, natural purification and bacterial die-off reduced the total coliform densities to 1,660,000 near Saundersville (B-12), 155,000 at Northbridge (B-11) and 22,500 at the outlet from Rice City Pond (B-10).

Within the next 9 miles, and approximately 2 days flow time, from Rice City Pond to the Massachusetts-Rhode Island State line, the bacterial pollution included in the untreated sewage discharges from Uxbridge, Millville, and local industries exceeded the bacterial reduction by natural purification in this reach and the total coliform density increased to 51,500 MPN/100 ml at the State line (B-7 at R.M.-22.3). One thousand MPN/100 ml, or approximately 2 percent of this total, were fecal coliform bacteria.

The total coliform bacteria content of Blackstone River water crossing the Massachusetts-Rhode Island State line was 10 times the objective for general recreational use, and 20 times the Massachusetts objective and 50 times the Rhode Island objective for water contact sports including swimming and skiing.

Below the State lines, raw sewage from Woonsocket, Rhode Island bypassed to the river during construction of the new treatment facilities, was primarily responsible for the sharp rise in coliform densities at the Manville Dam (B-3). At this point the median total coliform density increased to 7.5 million MPN/100 ml and the fecal coliform density increased to 1,300,000 or 17.5 percent of the total.

Total coliform densities in this grossly polluted reach of the river were 1,500 times the objective for general recreation, 7,500 times the Rhode Island objective for water contact sports, and more than one-third the density than can be expected in raw sewage.

Below Manville, the bacterial pollution had been reduced by natural purification but at Central Falls (B-1) the 255,000 MPN/100 ml total coliform density was still 50 times the general recreation objective and 250 times the objective for water contact sports.

Bacteriological data collected during the August 1964 survey, and illustrated on Figure 7, show that unchlorinated raw and partially treated sewage discharged in Massachusetts polluted the interstate waters of the Blackstone River flowing across the State line from Massachusetts into Rhode Island. In addition to creating extremely severe local pollution, sewage discharges in Massachusetts, principally from Worcester, and in Rhode Island, principally from Woonsocket, endangered the health of all persons who might contact Blackstone River water anywhere throughout this entire 40-mile reach of the river.

Ten Mile River

The Ten Mile River was also severely polluted by sewage-associated bacteria. The coliform content of river waters observed during the August 1964 survey is reported in the Appendix Tables and illustrated on Figure 8.

Bacteriological water quality objectives were exceeded in the vicinity of North Attleboro but the most serious pollution occurred below Attleboro near the State line.

Total coliform densities increased from 5,500 MPN/100 ml at the dam in the pool immediately above Attleboro Dyeing and Finishing Company to 3,400,000 at the next station located 0.1 mile downstream, but 0.2 mile above the Attleboro sewage treatment plant. The source of this increase, which amounted to about 3,000 bacterial population equivalents and was too large to be attributed to the upstream mill, was not found during the survey.

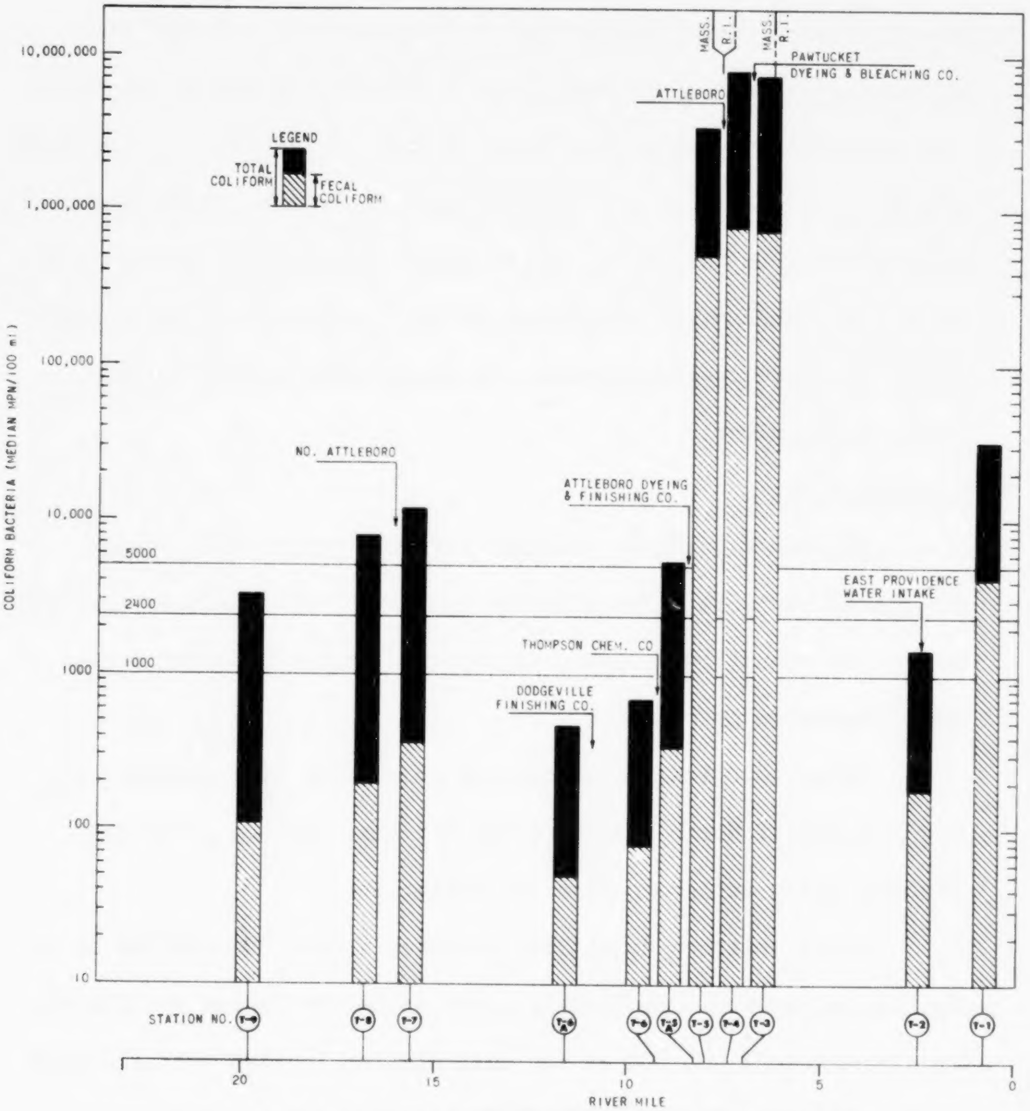


Figure No. 8. TOTAL & FECAL COLIFORM BACTERIA - TEN MILE RIVER - AUGUST, 1964

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Unchlorinated effluent from the Attleboro sewage treatment plant, which entered the river about 0.1 of a mile above the first Massachusetts-Rhode Island State line, was responsible for the largest coliform increase in Ten Mile River waters flowing from Massachusetts to Rhode Island. At Rhode Island Station T-4, located 0.3 miles below the first State line, the median total coliform density soared to 7.9 million MPN/100 ml which included 795,000 or 10 percent fecal coliform bacteria. Seven-and-one-half (7.5) million total coliform MPN/100 ml remained at Central Avenue, on the second Massachusetts-Rhode Island State line located 0.7 mile farther downstream.

After flowing another three-and-one-quarter miles through Central Pond and the East Providence Reservoir, the median total coliform density was reduced to 1,500 MPN/100 ml, with 185 MPN/100 ml or 12 percent fecal coliform, at the source of supply for the East Providence municipal water supply treatment plant.

Unidentified sources of additional bacterial pollution entered the river in the next mile and three quarters to increase the median total coliform density to 33,000 MPN/100 ml at Roger Williams Avenue located about 0.8 mile above the mouth.

Sewage-associated bacteria, discharged into the river in Massachusetts polluted the interstate waters of Ten Mile River flowing into Rhode Island. This pollution, which exceeded the 5,000 MPN/100 ml general recreation objective by 1,500 times at the State line, presented a serious hazard to persons, especially children who may come in contact with the water while playing and wading in the river.

AQUATIC LIFE

Environments in which aquatic organisms live can be modified by man-produced pollution, or by natural pollutants that may be catastrophically introduced into the aquatic environment. Unpolluted water courses support many kinds of clean-water-associated bottom organisms such as mayflies, stoneflies, alderflies, certain beetles, and caddisflies. Some intermediate forms such as snails, craneflies, sowbugs, and certain midges also may be present, and pollution-tolerant organisms consisting of sludgeworms, certain leeches, and midges with special respiratory organs usually are few in number. Stream conditions that permit the development of an assemblage of clean-water-associated forms provide food for fishes and prevent development of nuisance organisms in large numbers.

Responses of aquatic organisms to domestic and industrial wastes depend largely on amounts and kinds of such materials entering their environments. One response is manifest by the loss of a few kinds of organisms that thrive only in clean water environments, while those associated with mildly polluted waters increase slightly in numbers. A more drastic response involves the disappearance of all clean-water-associated forms and the development of pollution-tolerant organisms often associated with sludges and slimes.

Biological surveys of the Blackstone and Ten Mile rivers were conducted in March and August, 1964 at stations shown in Table 1.

Blackstone River

Bottom samples collected in March from Tatnuck Brook, a headwater tributary of the Blackstone River above Worcester, Massachusetts, contained 20 different kinds of organisms including clean-water-associated stoneflies, mayflies, riffle beetles, and caddisflies (Table 14). As in Tatnuck Brook, many different kinds of bottom organisms are to be found in stream reaches not affected by pollution. The number of individuals representing each kind are small because of predation among species and competition for food and space.

Sludge deposits, oily substances, and slime growths found in the Blackstone River at the southeastern edge of Worcester, Massachusetts (mile 47.9), supported dense populations of sludgeworms (Figure 9, Tables 14 and 15). Such pollution-tolerant populations (20,352 sludgeworms per square foot) are dependent on an abundant supply of organic wastes, and reflect the severely polluted character of the stream in this reach. Although the natural stream bottom throughout the entire Blackstone River could, if not polluted, support many different kinds of aquatic life, only pollution-tolerant sludgeworms were present in samples collected between Worcester and the eastern edge of Wilkinsonville, Massachusetts. In March, such

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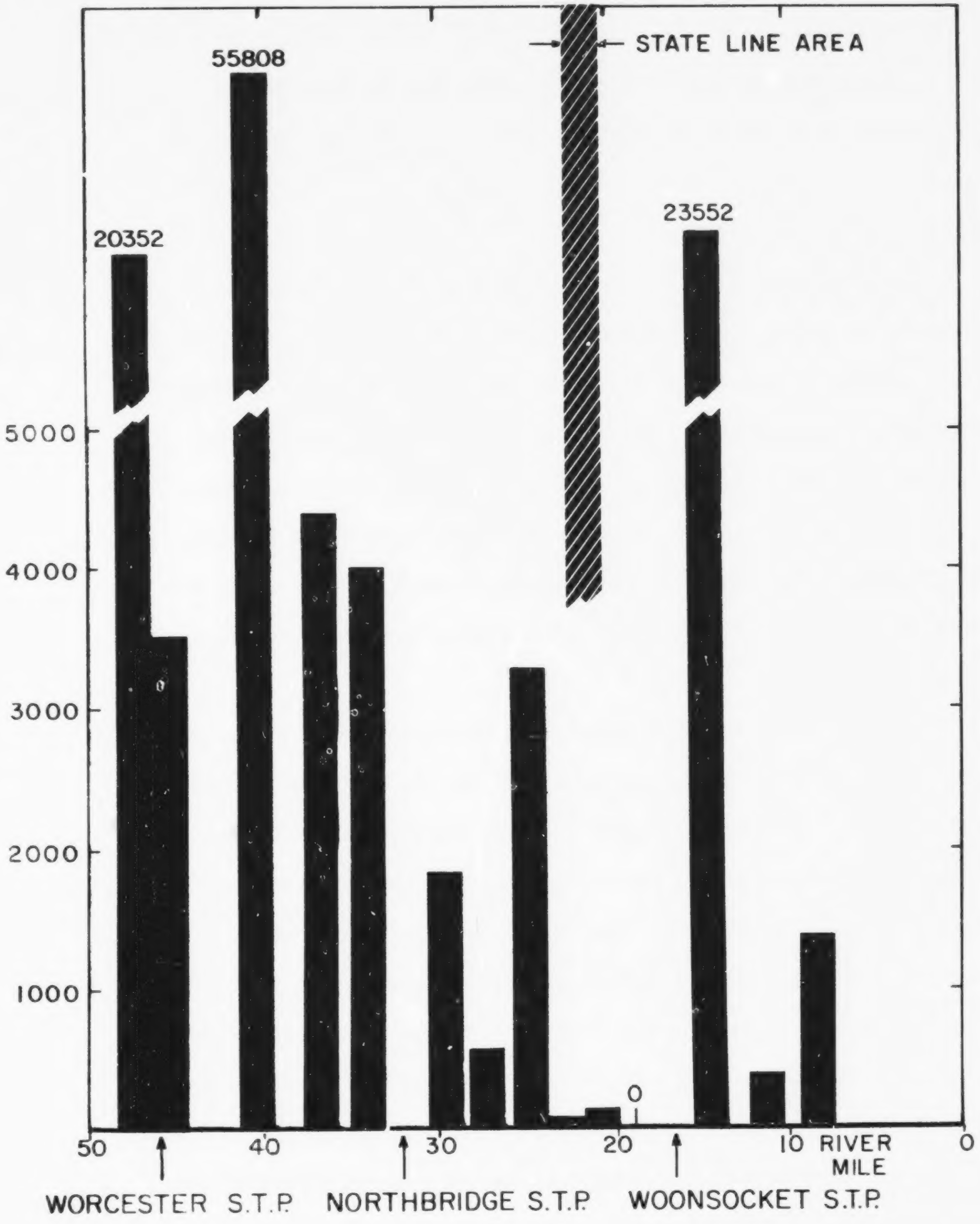


NUMBERS OF POLLUTION-TOLERANT BOTTOM ORGANISMS, PER SQUARE FOOT, BLACKSTONE RIVER, AUGUST, 1964

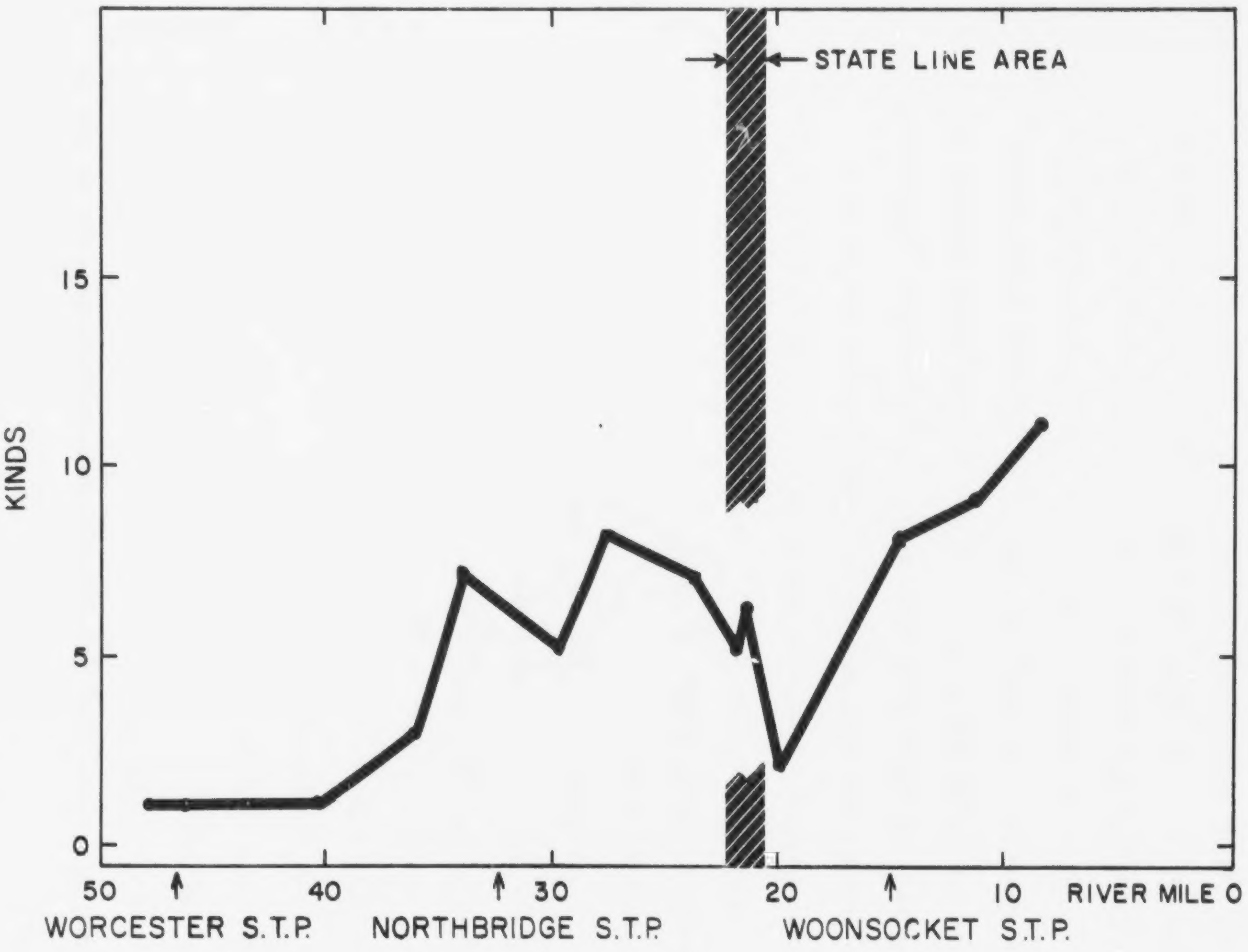
FIGURE 9

conditions persisted farther downstream to the Northbridge area. Summer temperatures and an abundant supply of nutrients in the Northbridge area produced dense growths of aquatic plants that held sludge deposits and supported slime growths. Floating masses of detergent foam also detracted from the river's aesthetic value.

In the downstream reach from Northbridge to Millville, Massachusetts (mile 25.0), the number of kinds of organisms remained low during March, but increased to 8 in August (Figure 10). Organisms associated with clean water were not found. Sludgeworms and other pollution-tolerant forms comprised most of the total bottom organism population, and in August the region contained abundant aquatic vegetation indicating a rich supply of nutrients. The presence of sludge deposits, oily substances, and slimes attested to the polluted condition.

Just below Millville, Massachusetts (mile 23.7), in excess of 3,000 pollution-tolerant sludgeworms were found in a square foot of bottom. Sludge deposits were evident along the sides of the stream for as much as 20 feet out from shore. No clean-water-associated fish food organisms were found.

The Blackstone River is impounded just upstream from the point where it first crosses the Massachusetts-Rhode Island State line. Abundant nutrients provide conditions favorable to the development of dense growths of aquatic vegetation, slimes, and attached algae downstream from the impoundment on both sides of the



KINDS OF BOTTOM ORGANISMS, BLACKSTONE RIVER, AUGUST, 1964

FIGURE 10

State line during the summer months. These growths precluded quantitative sampling to determine the density of individuals comprising the various kinds of bottom organisms. Qualitative sampling, however, showed six kinds of bottom organisms living in this weedy reach: one form of caddisfly represented the sole clean-water-associated bottom organism; three kinds were intermediate forms (blackflies, snails, and midges without blood gills); and the remaining two kinds were pollution-tolerant organisms comprised of leeches and sludgeworms. If vegetative growths and algal slimes were not so abundant, other clean-water-associated organisms, such as stoneflies, riffle beetles, mayflies, hellgrammites, etc., could abound in the area. If fish were present in this short reach it would be doubtful that they could utilize the existing food supply because the organisms were in the root mass of the attached vegetation, and it would be doubtful that game fish could forage in such a densely vegetated area. Also, because of dense vegetation it is unlikely that fish could utilize this area for spawning. Attached algae, slimes, and aquatic vegetation do not present an aesthetically pleasing sight. This stream reach was polluted.

Below the Massachusetts-Rhode Island State line just above the confluence with the Branch River in Rhode Island, the density of aquatic vegetation in the Blackstone River was much reduced and sludge deposits were not observed. The population of bottom organisms remained low and no clean-water-associated organisms were found. Below the Branch River, wastes carried by the Branch River contributed to the pollution of the Blackstone River. Aquatic plants were very abundant, and these were covered with slimes consisting of bacteria and filamentous algae. Variously colored wool fibers similar to those found in the Branch River also were observed upon microscopic examination of samples collected in this area. Extensive sludge deposits and oily substances covered much of the gravel on the stream bottom. Turbidity of the river in this section was sufficient to give the water a dark gray appearance. Such conditions show pollution of the Blackstone River. At the Singleton Street Bridge, Woonsocket (1.9 miles below the confluence with the Branch River), total kinds of organisms were reduced to 2 from 6 at the station immediately upstream. The total numbers of bottom organisms per square foot were reduced to 13 from 464 immediately upstream. Toxicity from the Branch River was evident.

Below Woonsocket, Rhode Island, extensive sludge deposits, a dense sludgeworm population of 23,040 organisms per square foot near river mile 14.6 (Figure 9), and the lack of organisms associated with clean water attested to pollution of the Blackstone River in this reach. Oily substances, detergent foams, slimes, floating solids, and refuse compounded the pollution problem. Although the lowermost reaches of the Blackstone River supported up to eleven kinds of bottom organisms in August, no clean-water-associated forms were found. The lack of clean-water-associated organisms and the predominance of pollution-tolerant forms show the extent of pollution throughout the remainder of the Blackstone River.

Samples of bottom organisms collected in March from Branch River downstream from Branch River Wool Combing Co. contained only a few sludgeworms (Table 16). Samples obtained from the same area in August had just two kinds of pollution associated organisms and these were represented by few individuals (Table 17). At Branch River mile 1.1, upstream from Branch River Wool Combing Co. but downstream from Stamina Mills (mile 1.7), five kinds of organisms were represented by few individuals; none were clean-water-associated forms. The stream bottom in this entire reach contained many wool fibers. Extensive sludge deposits, floating balls of wool fibers impregnated with grease, and slimes on bottom materials also were noted. The intensely polluted condition of this reach of Branch River and toxicity of the water to bottom organisms compounded pollution of the Blackstone River below their confluence.

During August, the Branch River at Slatersville, Rhode Island (mile 2.6), supported 17 kinds of organisms including six clean-water-associated forms such as mayflies, caddisflies, and riffle beetles. These bottom organisms represent good water quality. The Chepachet and Pascoag rivers form the Branch River near Mapleville, Rhode Island. Upstream from this junction, the Chepachet River supports 13 kinds of organisms including clean-water-associated mayflies, caddisflies, and beetles; pollution-tolerant forms were not found in this area. Such an assemblage of organisms comprises an abundant supply of food for the fish in the area.

The Mumford River is polluted where it joins the Blackstone River at Uxbridge, Massachusetts. Although eleven kinds of organisms were observed, only one clean-water-associated form was found, and these occurred in low numbers (Table 17). Similar stream conditions were noted at river mile 1.2 between Uxbridge and North Uxbridge, Massachusetts. A short distance upstream at Whitinsville, Massachusetts, rocks on the stream bottom were sufficiently cemented together with a reddish precipitate to preclude quantitative sampling. Qualitative sampling, however, disclosed no organisms in March and only a few kinds in August. The lack of clean-water-associated forms indicates pollution in this area of the Mumford River.

Effluents entering the Mumford River just below the Hayward-Schuster Woolen Mills Inc. Co. produced intense pollution downstream near river mile 7.4. In March no animal organisms were found, while in August such forms were represented by only a few midges and sludgeworms. Large mats of wool fibers impregnated with grease, algae, and slimes were observed on bottom materials and vegetation projecting into the stream. Six kinds of bottom organisms were found just above this effluent, and wool fibers, grease, and slimes were not observed. At mile 11.6 and 10.2, above the Hayward-Schuster Woolen Mills Inc. Co. and the Einiger Corporation, 7 kinds of clean-water-associated organisms indicated suitable water for aquatic life.

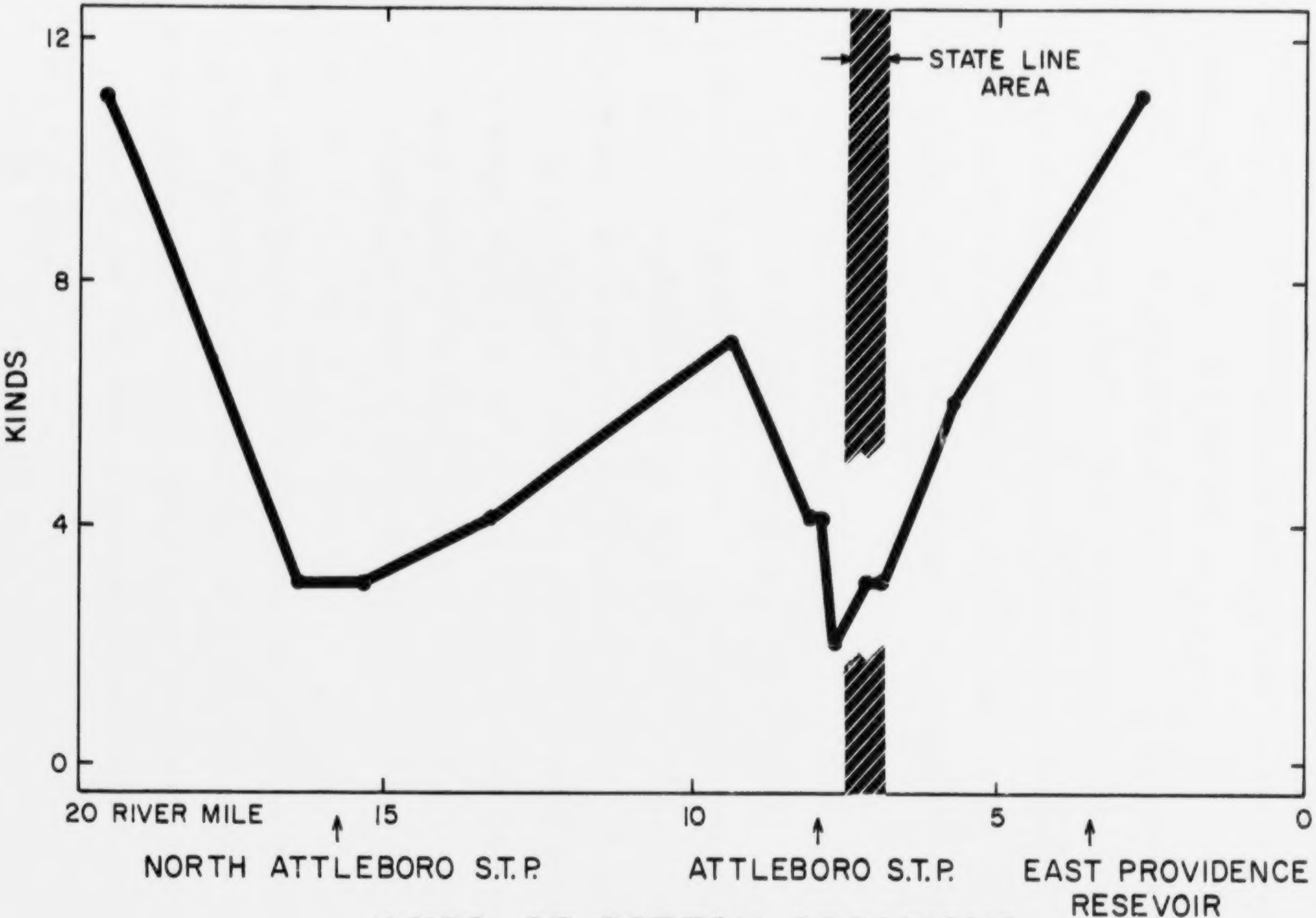
Prior to its confluence with the Blackstone River and below Waucantuck Woolen Mills Inc Co., the West River supported 6 kinds of organisms; none of these represented the clean-water-associated group. Aquatic life in the West River shows the effects of moderate pollution.

In summary, a study of bottom organisms of the Blackstone River showed stream degradation from wastes originating in Worcester, Massachusetts, and with additional waste contributions in downstream reaches, the polluted bottom conditions extended through Woonsocket, Rhode Island. The Blackstone River receives polluted water from the Mumford River in Massachusetts, and in the region of the State line, from the Branch River in Rhode Island. Pollution from Woonsocket further degraded the stream below this point.

Ten Mile River

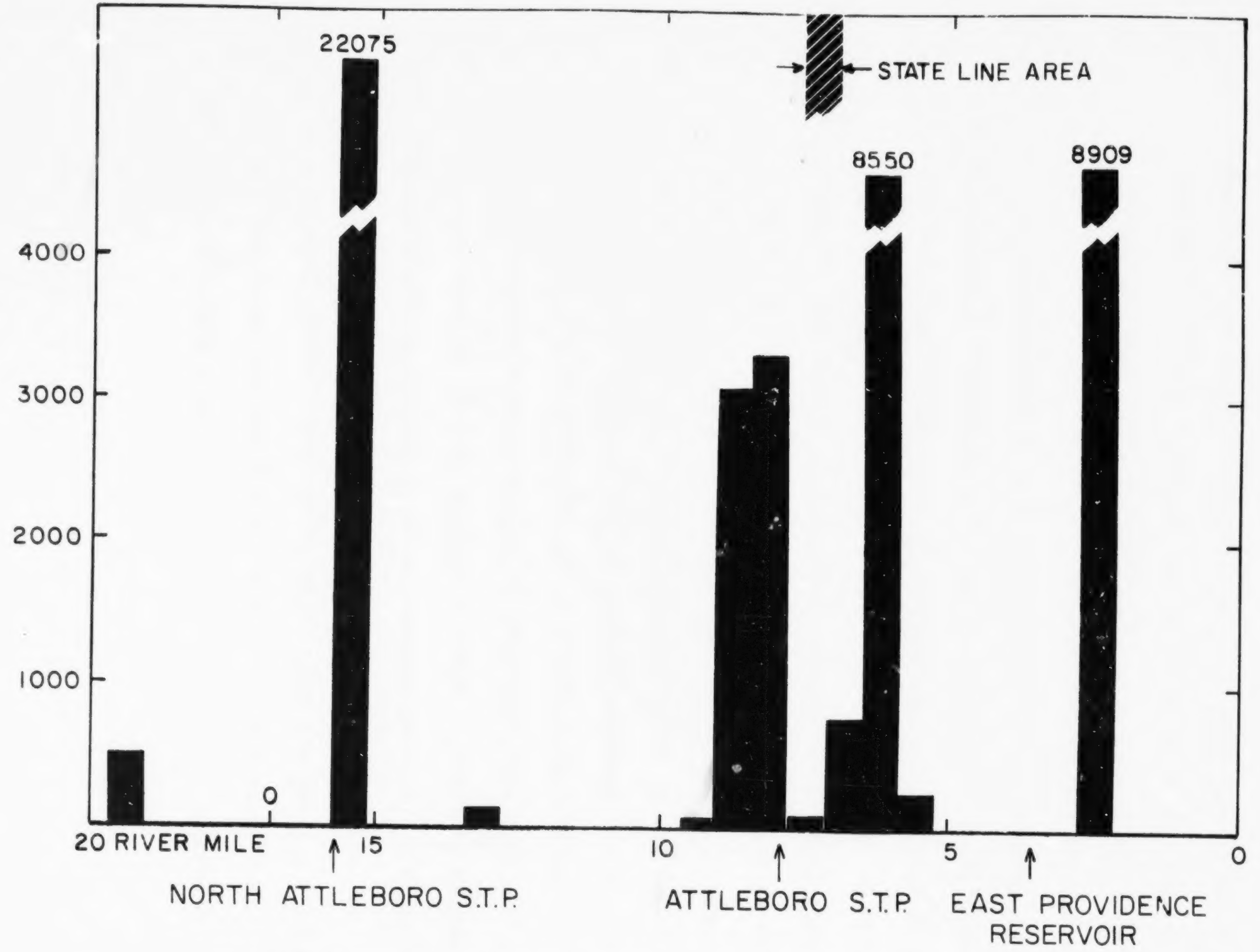
Ten Mile River is severely degraded from below Whiting Pond in North Attleboro, Massachusetts, to the point where it joins the Seekonk River in East Providence, Rhode Island. In this 19 mile reach, Ten Mile River supports a minimal population of clean-water-associated organisms only in its upper reach above North Attleboro (Figures 11 and 12; Tables 18 and 19).

A paucity of bottom organisms occurred near the southern edge of North Attleboro. Some improvement, however, was noted downstream a short distance below



KINDS OF BOTTOM ORGANISMS,
TEN MILE RIVER, AUGUST, 1964

FIGURE 11



NUMBERS OF POLLUTION-TOLERANT ORGANISMS, PER SQUARE FOOT, TEN MILE RIVER, AUGUST, 1964

FIGURE 12

Coral Lake above the North Attleboro sewage treatment plant. Bottom organisms in this area consisted of a hellgrammite and two midges (Table 19). Algal slimes also were present. This reach has the potential to support additional kinds of bottom life, but such potential is inhibited by moderate pollution.

Extensive sludge deposits, slimes, microscopic stalked forms, and pollution-tolerant populations of sludgeworms and midges approaching 22,000 organisms per square foot of stream bottom were found in the reach between the North Attleboro sewage treatment plant and Farmers Pond near Attleboro, Massachusetts (Figure 12). Pollution-tolerant sludgeworms and midges were less abundant downstream in Attleboro. Few different kinds of organisms and the presence of extensive sludge deposits impregnated with grease indicate severe pollution and probable toxicity in this reach of Ten Mile River.

During August, wastes in Ten Mile River at Attleboro contributed sufficient nutrients to support dense populations of a suspended microscopic organism (Euglena sp.) in the pond at Hebronville. Such populations, about 19 million organisms per quart of pond water (20,000 per ml), accounted for high turbidities and imparted a green unsightly color to the water. Seven kinds of bottom organisms were found in Ten Mile River just below the pond at Hebronville in August, but none of these were associated with clean water.

Only 4 kinds of bottom organisms were present in Ten Mile River above an unnamed tributary and the Attleboro sewage treatment plant. Pollution-tolerant midges and sludgeworms were well represented, and stream bottom materials were covered with oily sludge and slimes. Below this tributary the number of individuals representing the four kinds of bottom organisms were much reduced. Although four kinds of organisms were still present in this reach, the decrease in numbers of individuals suggests that wastes entering Ten Mile River from the unnamed tributary were toxic. No organisms were found below the Attleboro Dyeing and Finishing Company in the oily sludge covered bottom of this purple-black unnamed tributary located just upstream from the State line on Ten Mile River. This severely polluted tributary contributes to interstate pollution at the State line.

At the first Massachusetts-Rhode Island State line crossing, pollution became more severe. Effluents from the Attleboro sewage treatment plant contributed to extensive deposition of sludge and, because of unsuitable water quality, a reduction in both numbers and kinds of bottom organisms occurred (Figures 11 and 12). Even sludgeworms found living difficult. Slimes, algae, and sludges covered much of the gravel and sandy stream bottom. At the second State line, Ten Mile River supported dense growths of aquatic weeds covered by stalked microscopic forms that indicated a bountiful bacterial food supply, and slimes. Bottom organisms in this polluted area consisted principally of pollution-tolerant midges and sludgeworms. Sludge was evident. A similar assemblage of organisms occurred at the third State line below the waste outfall from the Pawtucket Dyeing and Bleaching Inc. plant. The effluent from the plant holding ponds was deep purple in color. The stream bottom at this point was covered with sludge, and rattail maggots - those organisms that are adapted to live in a stream devoid of oxygen - were observed where the effluent enters Ten Mile River.

Improved water quality was indicated downstream above East Providence Reservoir (mile 5.8) since this reach of Ten Mile River supported 6 kinds of bottom organisms in August and 4 kinds in March. However, clean-water-associated forms were lacking and pollution-tolerant forms such as sludgeworms, leeches, and midges with blood gills were present. Algal slimes, and dense growths of aquatic plants also were noted. The condition of the water is such that in all probability a game fish population could not be supported.

Although 11 kinds of bottom organisms were present just below the East Providence Reservoir, the lack of clean-water-associated forms also shows the effect of pollution in this reach of Ten Mile River.

Ten Mile River was severely degraded by pollution from below Whiting Pond in North Attleboro, Massachusetts, to the point where it joins the Seekonk River in East Providence, Rhode Island. At the Massachusetts-Rhode Island State lines, sludge deposits and slime growths were evident, and aquatic animal life was limited to those tolerant organisms that could withstand a polluted environment.

OXYGEN DEMAND AND DISSOLVED OXYGEN

Sewage and many industrial wastes contain organic matter that decomposes and exerts an oxygen demand in the receiving stream. In the process of decomposition, oxygen derived from the atmosphere and dissolved in the water is used, and the normal content of dissolved oxygen (DO) is reduced. If the DO is reduced below an adequate level, the fish population and the aquatic life on which the fish feed are killed or driven out of the area. Most water pollution control agencies have adopted a minimum 5 mg/l DO objective to maintain the maximum potential warm water sport fish population.

Both Massachusetts and Rhode Island have adopted 5 mg/l as one of the minimum standards of quality for Class C waters. One of the definitions of Class C water is "...suitable...habitat for wildlife and common food and game fishes indigenous to the region..."

Blackstone River

5-Day Biochemical Oxygen Demand

The Blackstone River was grossly polluted by oxygen-demanding sewage and industrial wastes in both Massachusetts and Rhode Island (Figure 13). The moderately high 6.5 mg/l B.O.D. at the uppermost sampling station, which indicated that non-intercepted oxygen-demanding wastes had entered the river in Worcester, increased sharply to 26.8 mg/l one-half mile below the Worcester sewage treatment plant outfall. This high demand, plus those from other downstream sources of wastes, severely polluted local reaches of the

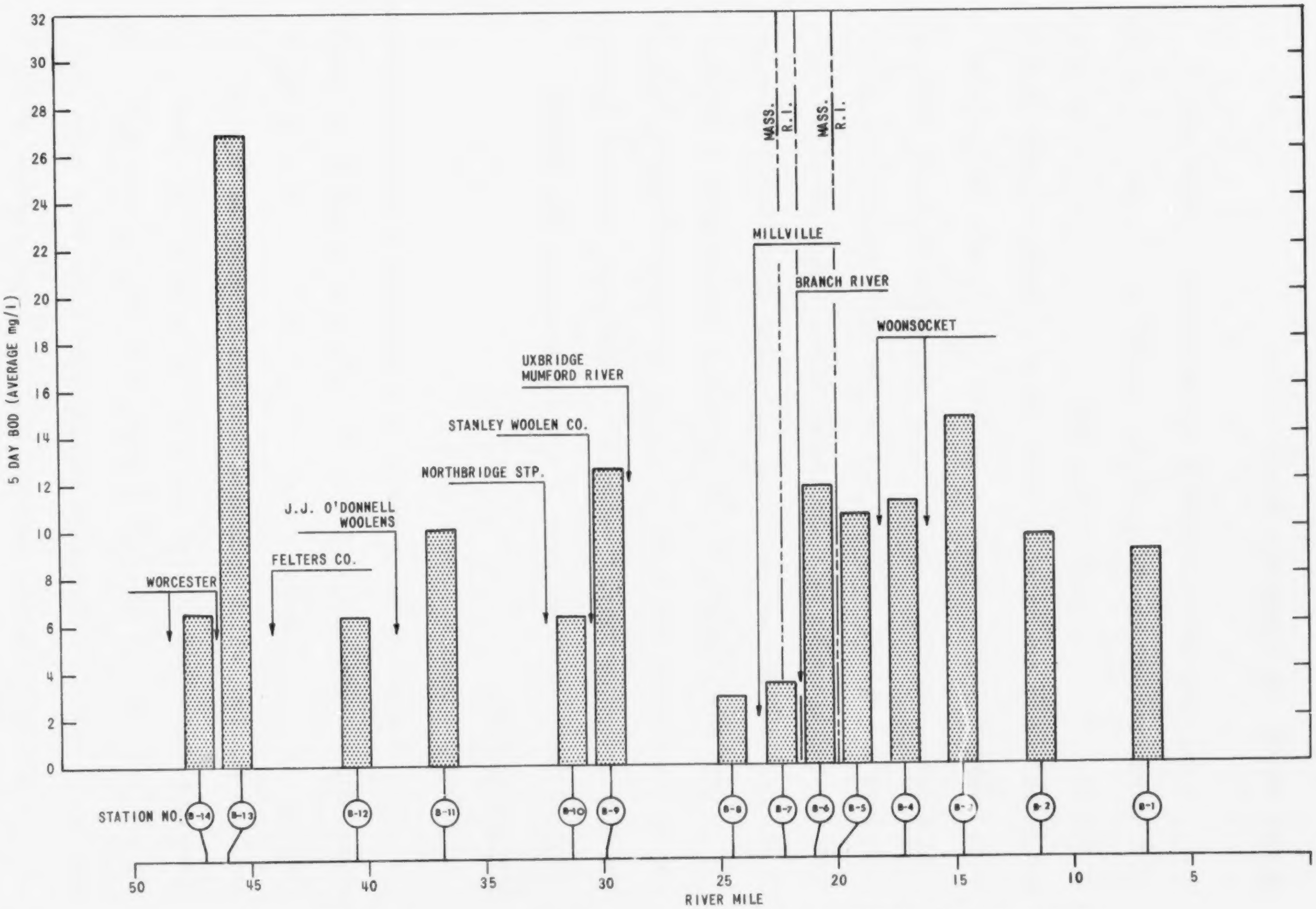


Figure No. 13. 5-DAY BIOCHEMICAL OXYGEN DEMAND (BOD) - BLACKSTONE RIVER - AUGUST 1964 river, but were largely satisfied by natural purification forces by the time the river reached the first Massachusetts-Rhode Island State line, where the B.O.D. had been reduced to 3.4 mg/l. These wastes had, however, taken their toll of river water dissolved oxygen in Massachusetts.

The Branch River in Rhode Island, which was polluted by wastes from the Stamina Mills and primarily from the Branch River Wool Combing Company, contained 88.4 mg/l B.O.D., which is phenomenally high for river water, about a mile above its confluence with the Blackstone River. This waste polluted the Blackstone River in both Rhode Island and in the Massachusetts reach near Blackstone, Massachusetts, where the river had again crossed the State line.

Sewage and industrial wastes from Woonsocket, Rhode Island, further increased the pollutional load carried by the river, and the B.O.D. was further increased to 14.7 at Manville, Rhode Island.

Below Manville, these wastes again reduced the dissolved oxygen, while the B.O.D. was reduced to the still high level of 9.5 mg/l at the Broad St. bridge in Central Falls, Rhode Island.

Dissolved Oxygen

While the 5-day biochemical oxygen demand figures show the degree of organic pollution, the dissolved oxygen concentration in the river, as shown on Figure 14, illustrates the adverse effects of this pollution on the aquatic life environment. Since fish and other aquatic life are adversely affected by minimum DO values,

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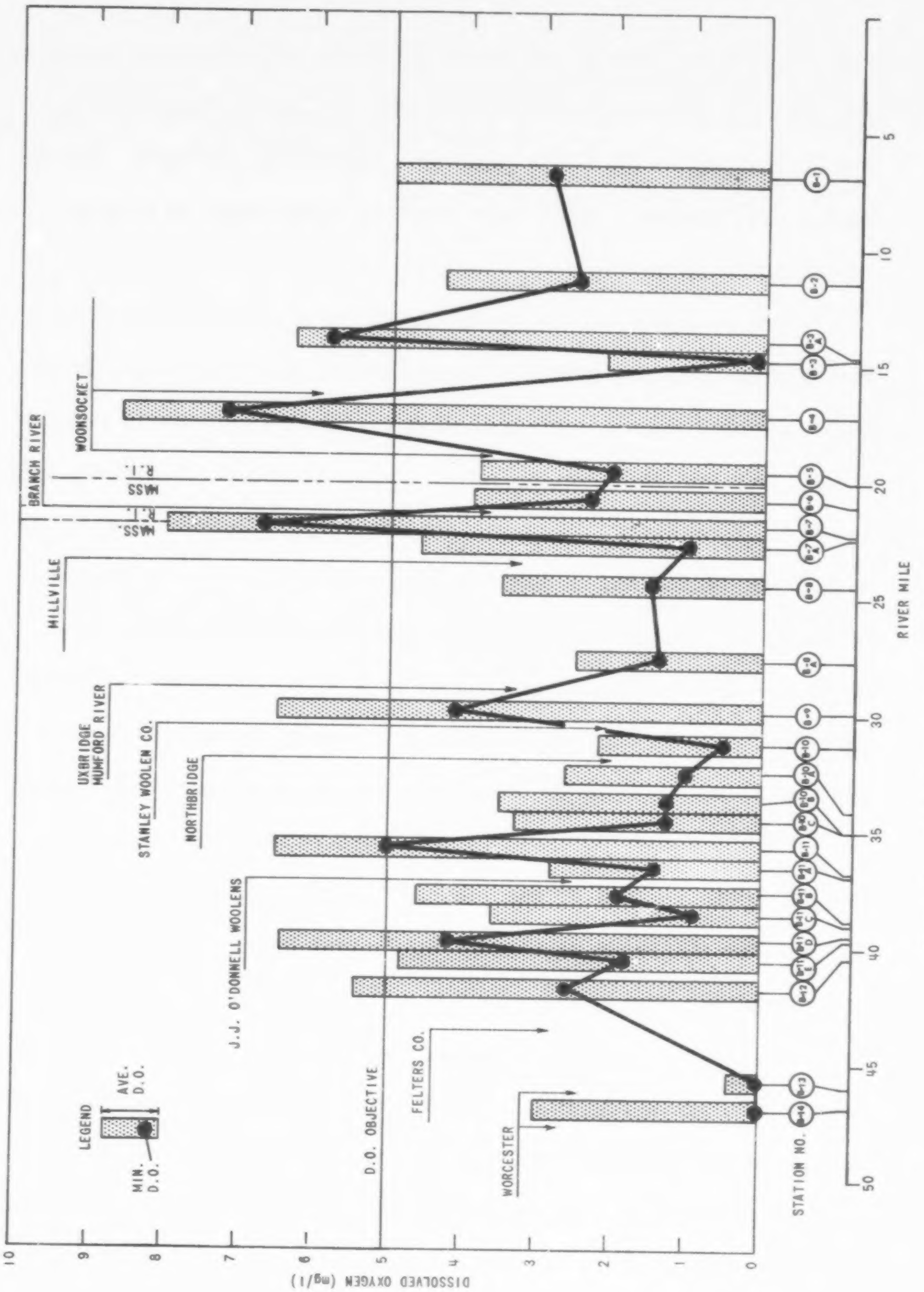

Figure No. 14. DISSOLVED OXYGEN - BLACKSTONE RIVER - AUGUST 1964 these minimums are more significant than the average conditions that prevailed throughout the survey.

The dissolved oxygen concentration of samples collected during the routine survey, shown on Figure 14, illustrates the drastic reduction in DO caused by the waste discharges, partial DO recovery following natural reaeration in normal stream channels and riffle areas, further loss of DO in impoundments, and the immediate, though temporary beneficial effect of reaeration where the river splashed over dams and rushed through intervening rapids.

Sewage and industrial wastes entering the river from Worcester reduced the average DO far below the 5 mg/l objective, and at times removed all dissolved oxygen from the river, both above and below the Worcester sewage treatment plant outfall. Natural reaeration, especially throughout the rapids in the vicinity of Millbury, added dissolved oxygen to the stream by the time it reached the Pleasant St. bridge in Saundersville (B-12), but upon flowing through the next impoundment, the DO was again lowered to an average of 4.8 and a minimum of 1.8 mg/l at the crest of the Fisherville dam.

Almost 2.5 mg/l of atmospheric oxygen were absorbed by the river splashing over the Fisherville dam, but the continued decomposition of the residual waste loads in the sluggish waters of the next downstream impoundment again reduced the minimum DO to less than 1 mg/l at the crest of the Farnumsville dam. This general pattern of partial recovery following reaeration, and then subsequent loss of river DO to the oxygen-demanding pollutional loads repeated itself as the river flowed down through Massachusetts.

In the pool immediately above the Lonsdale dam, 500 feet upstream from the first Massachusetts-Rhode Island State line, the minimum DO value showed that at times the river contained only 1.0 mg/1 of dissolved oxygen.

Fortunately for the downstream reach of river in Rhode Island, the river was again reaerated as it splashed over the dam and rushed down the 500 feet of rapids to the State line, where the dissolved oxygen content was increased to a minimum of 6.7 mg/1, and an average of 10.2 mg/1.

Wastes from the Stamina Mills and the Branch River Wool Combing Company, discharged into the Branch River in Rhode Island, in combination with the B.O.D. residual from Massachusetts, polluted the interstate waters of the Blackstone River and reduced its dissolved oxygen below the objective for fish and aquatic life as it crossed the second State line into the Massachusetts loop at Blackstone, Massachusetts. At Bridge Street in Blackstone, Massachusetts, the DO averaged 3.9, the minimum value fell to 2.3, and 70 percent of all samples collected contained less than the 5 mg/1 dissolved oxygen objective.

After crossing the State line for the third time, and reentering Rhode Island, the DO content of the waters was repeatedly depressed by the decomposition of wastes and increased by reaeration over a series of dams; but the overpowering effect of Woonsocket sewage and industrial wastes reduced the average DO to 2.1, and the minimum dissolved oxygen to 0.1, or almost zero, in the pool immediately above the Manville, Rhode Island, dam.

At the Broad Street bridge in Central Falls, Rhode Island, the average DO increased to 5 mg/1, but the minimum was only 2.9 mg/1.

Industrial wastes and partially treated sewage, entering the Blackstone River in Massachusetts, degraded local reaches of the river to levels that were intolerable to desirable fish and aquatic life, but reaeration at the Lonsdale dam increased the DO of the river water above the 5 mg/1 objective as it flowed into Rhode Island.

Wastes from Stamina Mills and the Branch River Wool Combing Company polluted the Branch River, which in turn polluted the interstate reach of the Blackstone River flowing from Rhode Island into the Massachusetts loop of the river.

Ten Mile River

5-Day Biochemical Oxygen Demand

The average 5-day B.O.D.'s of river water samples collected from the Ten Mile River during the August 1964 survey are shown on Figure 15. The B.O.D. increased from 4.3 mg/1 above the North Attleboro sewage treatment plant to 9.1 below the sewage plant, to 12.4 below the Dodgeville Finishing Company, with a further sharp increase to 25.8 below Thompson Chemical Company. Successive waste

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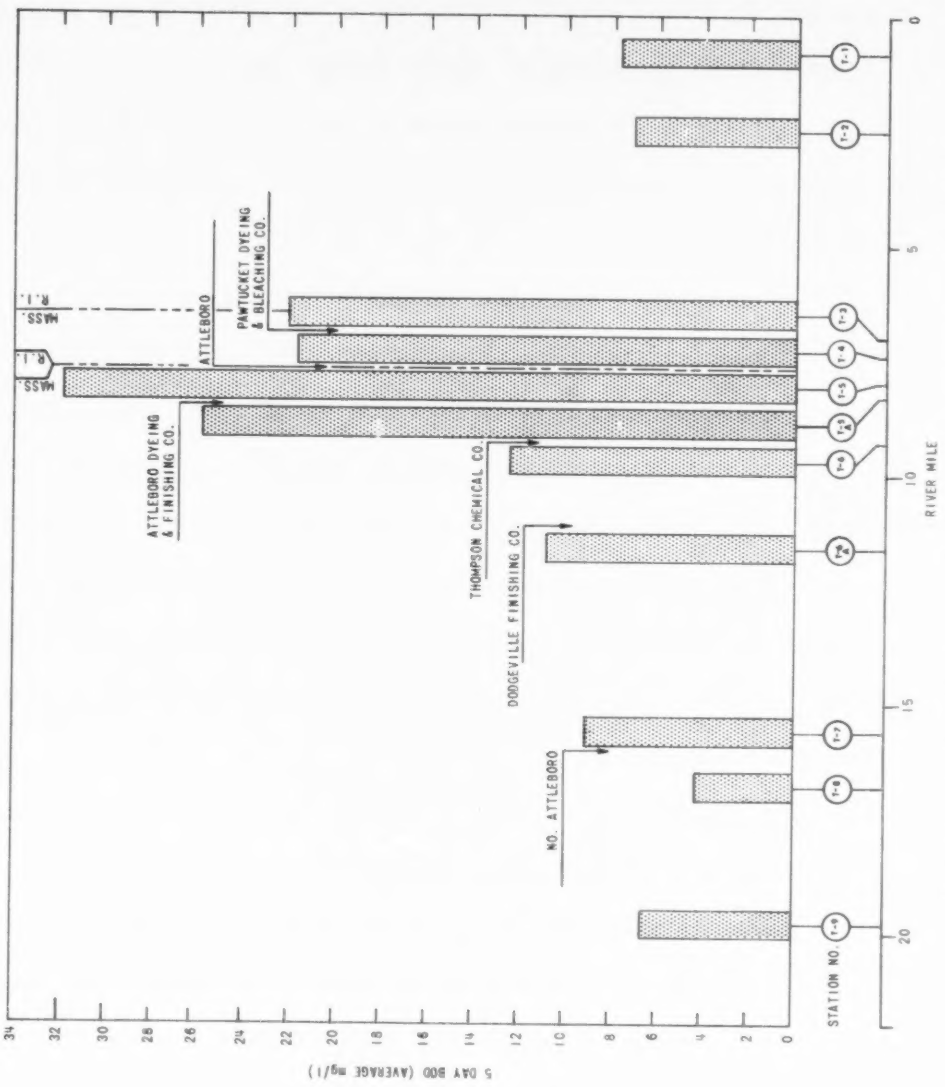

Figure No. 15. 5-DAY BIOCHEMICAL OXYGEN DEMAND (BOD) - TEN MILE RIVER - AUGUST 1964 discharges greatly exceeded the recovery capacity of the stream, and additional wastes from the Attleboro Dyeing and Finishing Company and the other undetermined source of sewage in Massachusetts finally increased the B.O.D. to a peak of 31.9 mg/l at sampling station No. T-5, located 0.3 of a mile above the first Massachusetts-Rhode Island State line. Although the B.O.D. of the river water was lower below the Attleboro sewage treatment plant and the Pawtucket Dyeing and Bleaching Company, it remained at the relatively high value of 22 mg/l where the river flowed back and forth across the State lines and finally into Rhode Island.

At the crest of the East Providence water supply reservoir dam, some 4-1/2 miles downstream in Rhode Island, the average B.O.D. was reduced to 7.1 mg/l. Additional wastes from unidentified sources enter the stream below the reservoir, and at the Roger Williams Ave. bridge, located 0.8 mile above the mouth, the B.O.D. had increased slightly to 7.7 mg/l.

Dissolved Oxygen

The extent to which these wastes discharges removed dissolved oxygen from the river and created local and interstate pollution problems is illustrated in Figure 16.

The river was practically saturated (8.9 mg/l) with dissolved oxygen upstream from the North Attleboro sewage treatment plant. At station T-6, 0.3 mile downstream, where the volume of treated sewage was 50 percent of the total river discharge, the dissolved oxygen of the Ten Mile River was severely reduced below the 5 mg/l objective

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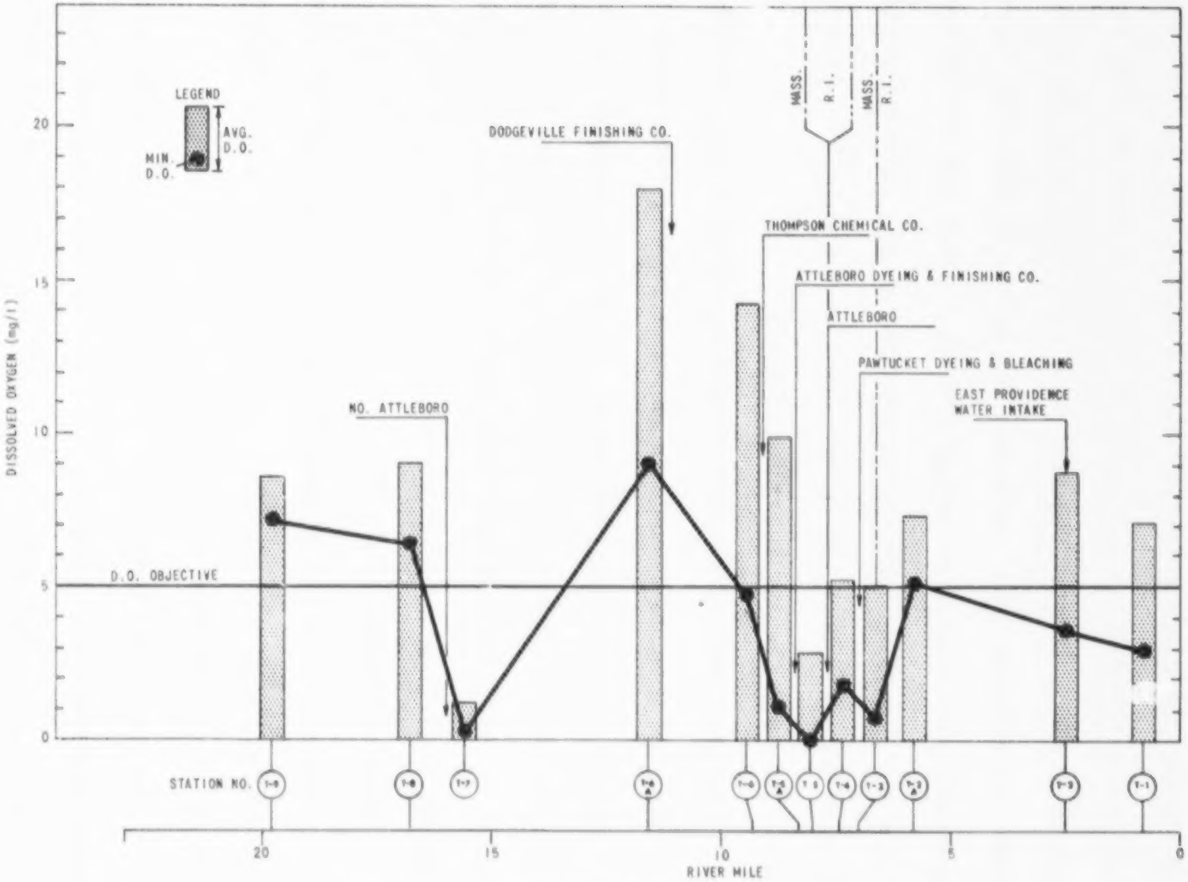

Figure No. 16. DISSOLVED OXYGEN - TEN MILE RIVER - AUGUST 1964 to an average of 1.2 and a minimum of 0.2 mg/l.

Downstream the river flowed through a series of ponds containing prolific algal growths, which produced and released oxygen into the water during daylight hours, and conversely removed dissolved oxygen from the waters at night. Dissolved oxygen information, collected during the routine survey which was conducted during daytime hours, is shown on Figure 16.[1] At the next three stations, in the pools above Dodgeville pond dam, the Hebronville dam, and the dam at Attleboro Dyeing and Finishing Company, the river was super-saturated with oxygen produced by algae during a portion of the daytime hours. The minimum daytime DO's, however, were reduced to 4.7 mg/l at the Hebronville dam below Dodgeville Finishing Company, and to 1.1 mg/l at the Attleboro Dyeing and Finishing Company dam, located below Thompson Chemical Company.

Between Attleboro Dyeing and Finishing Company and the Attleboro sewage treatment plant, 0.3 of a mile above the first State line, the DO averaged 2.8 mg/l, and was depressed to a minimum of zero during the daylight hours. At the third State line, at the Central Ave. bridge, DO of the water flowing into Rhode Island averaged 5 mg/l, but the daytime minimum was 0.7, and the nighttime minimum was zero mg/l.

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[1] Nighttime DO's observed during the special 48-hour, around-the-clock survey are included in the Appendix, Tables 28 and 29.

An additional set of samples were collected at approximately 4-hour intervals during a special 48-hour around-the-clock DO study (Table 28). The average DO's of these determinations were reduced from 8.3 mg/l at the dam above the Attleboro Dyeing and Finishing Company, to 4.1 mg/l below Attleboro Dyeing and Finishing Company, to 3.3 mg/l below the Attleboro sewage treatment plant, and to 2.0 mg/l at the State line at Central Avenue below the Pawtucket Dyeing and Bleaching Company. The minimum DO's in this series were 2.4 above and 0.6 below Attleboro Dyeing and Finishing Company and 0.0 at each of the two other downstream stations.

Average dissolved oxygen concentrations exceeded 5 mg/l at the Pawtucket Golf Club dam, about 2 miles below the State line, and throughout the next six miles to the mouth. The minimum DO concentrations were reduced to 3.6 at the East Providence Water Works intake, and 2.9 at the Roger Williams Avenue bridge, 0.8 mile above the mouth.

Wastes from the Dodgeville Finishing Company, Thompson Chemical Company, Attleboro Dyeing and Finishing Company, an unidentified source below Attleboro Dyeing and Finishing Company, and effluent from the Attleboro sewage treatment plant, all located in Massachusetts, and the Pawtucket Dyeing and Bleaching Company, located in Rhode Island, polluted the interstate reach of Ten Mile River, and were responsible for the removal of dissolved oxygen from the river waters, which produced conditions intolerable to desirable fish and aquatic life in the interstate Ten Mile River flowing across the State lines into Rhode Island.

AESTHETIC CONSIDERATIONS

The adverse effects of floating solids on the beauty of the Blackstone River have already been mentioned. Other floating and suspended materials, such as slimes and refuse, are further evidence that the Blackstone and Ten Mile rivers are badly polluted. Household type detergents in sewage and commercial type detergents in industrial wastes generated unsightly foam, that billowed on the water surface and scudded through the air above the turbulent Blackstone River, below the dams, from Northbridge, Massachusetts, to Central Falls, Rhode Island. The amount of common household detergent, ABS (alkyl benzene sulfonate) in the river waters is shown in Table 35. These values do not include the undetermined amount of phosphorus base commercial type detergents normally used in commercial launderies and textile mill operations. In addition, the Blackstone River contains masses of floating wool fibers and has a dark grey color, typical of organic pollution, that renders its appearance unsightly.

Wastes from Stamina Mills and primarily from the Branch River Wool Combing Company defiled the Branch River, and were responsible for the river's nauseating appearance from Branch Village to its confluence with the Blackstone River.

Various objectionable unnatural colors attributable to industrial wastes are intermittently displayed in Ten Mile River. Unsightly sludges, slimes, and excessive aquatic vegetation were apparent in the State line reach.

APPENDIX

Table 1
Sampling and Reference Point Location
Blackstone & Ten Mile Rivers
August, 1964 Survey

Station Number	River Mile	Description
Blackstone River		
-	49	Tatnuck Brook enters.
-*	47.9	Millbury St., Worcester, Mass.
B-14	46.9	U.S. Rt. 20 Bridge
-	46.6	Worcester, Mass. Sewage Treatment Plant.
- *	46.1	Below Worcester Sewage Treatment Plant.
B-13	46.0	Mass. Rt. 146 Bridge.
	44.8	The Felters Co., Millbury, Mass.
-	43.7	W. W. Windle Wool Scouring Co., Millbury
-	43.7	A. D. Windle Wool Scouring Co., Millbury
-	43.8 to 44.7	Millbury Sewage.
-	42.2	Dam, Sagdaw Storage Co.
-	42.1	Snider Packing Co.
-	41.2	Dam, Saundersville.
B-12*	40.5	Pleasant St. Bridge., Saundersville, Mass.
	39.7+	Quinsigamond River enters.
B-11E	39.7	Above Fisherville Dam.
-	39.7-	Dam, Fisher Mfg. Co.
B-11D	39.5	Mass. Rt. 122A Bridge., Fisherville, Mass.
B-11C	39.0	Above Farnumsville Dam.
-	38.9	Dam at Farnumsville.
B-11B	38.8	Ferry St. Bridge., Farnumsville, Mass.

* Indicates Biological Sampling Station.

Table 1
Sampling and Reference Point Location
Blackstone & Ten Mile Rivers
August, 1964 Survey

Station Number	River Mile	Description
Blackstone River (cont.)		
	38.8-	O'Donnell Woolens, Inc., Farnumsville, Mass.
B-11A	36.9+	Above Dam off Main St., Northbridge, Mass.
	36.9	Dam above Northbridge, Northbridge, Mass.
-	36.8+	Coz Chemical, Northbridge, Mass.
B-11 *	36.8	Sutton St. Bridge., Northbridge, Mass.
-	36.7	U.S.G.S. Gage., Northbridge, Mass.
B-10C	35.0+	Above Dam, Riverdale, Mass.
-	35.0	Dam, Kupfer Bros. (Riverdale)
B-10B	35.0-	Below Dam.
B-10A *	34.1	Church St. Bridge
-	32.4	Northbridge Sewage Treatment Plant effluent.
B-10	31.3	Hartford Rd. Bridge
	31.3-	Dam forming Rice City Pond.
-	30.0	Stanley Woolen Co., Uxbridge, Mass.
B-9	29.9+	Mass. Rt. 16 Bridge (Mendon St.), Uxbridge, Mass.
- *	29.9	Above confluence with Mumford River.
-	29.5	Mumford River enters.
-	28.7	West River enters.
B-8A *	27.7	Mass. Rt. 122 Bridge
- *	26.0	Power line above Millville, Mass.

* Indicates Biological Sampling Station.

Table 1
Sampling and Reference Point Location
Blackstone & Ten Mile Rivers
August, 1964 Survey

Station Number	River Mile	Description
Blackstone River (cont.)		
B-8	24.5	Central St. Bridge, Millville
-	24.3	Blackstone Wool Scouring Co.
-	24.0	Millville Sewage.
-	23.7	Upper reach Lonsdale Dam.
B-7A	22.4	Dam, Lonsdale Co.
B-7 *	22.3	Mass.-Rhode Island State line
B-7B	22.0	Immediately above confluence with Branch River.
-	21.9	Branch River enters.
- *	21.7	Below confluence with Branch River.
-	21.3	Rhode Island-Mass. State line.
B-6	21.0	Bridge St., Blackstone, Mass.
-	20.4	Mass.-Rhode Island State line.
B-5 *	20.0	Singleton St. Bridge, Woonsocket, R. I.
-	18.7	Dam, Woonsocket Falls
-	18.3	Bernon Dam, Woonsocket, R. I.
-	17.6	U.S.G.S. Gage
B-4	17.2	Hamlet St. Bridge, Woonsocket, R. I.
-	16.9	Woonsocket, R. I. Sewage Treatment Plant
- *	16.5	Woonsocket, R. I. City Dump
- *	15.0	Below Woonsocket, R. I. Water Treatment Plant.

* Indicates Biological Sampling Station.

Table 1
Sampling and Reference Point Location
Blackstone & Ten Mile Rivers
August, 1964 Survey

Station Number	River Mile	Description
Blackstone River (cont.)		
B-3	14.7	Above Manville Dam.
	14.7-	Manville Dam.
B-3A *	14.6	Rhode Island 120 Bridge (below Dam).
	14.5	Manville Sewage
-	12.9	Albion Dam
	12.7	Albion Sewage
B-2	11.4+	Above Ashton Dam
	11.4	Ashton Dam
- *	11.3	Below Ashton Dam
	11.0	Ashton Sewage
- *	10.3+	Above Berkeley Rd. Bridge.
- *	10.3-	Below Berkeley Rd. Bridge.
	10.0	Berkly Sewage
-	9.0	Lonsdale Dam
- *	7.9	Front St. Bridge, Lonsdale, Rhode Island
B-1	6.9	Broad St. Bridge
-	6.8	Sayles Finishing Co. Dam
-	5.8	Central Falls Dam
-	5.1	Old Slater Mill Dam
-	5.0	B.V.G.&E. Co. Dam
-	0.0	5 mi. below B.V.G.&E. Co. Dam (confl. Seekonk & Providence River

* Indicates Biological Sampling Station.

Table 1
Sampling and Reference Point Location
Blackstone & Ten Mile Rivers
August, 1964 Survey

Station Number	River Mile	Description
Blackstone River Tributaries		
Tatnuck Brook enters Blackstone River at B-49.0		
- *	9.6	Tatnuck Brook
	0.0	Mouth
Quinsigamond River enters Blackstone River at B-39.7+		
-	5.6	U.S.G.S. Gage
Q-1	1.8	Church St. Bridge, Grafton, Mass.
-	0.0	Mouth
Mumford River enters Blackstone River at B-29.5		
- *	11.6	Oxford-East Douglas St. Bridge (E. of Manchaug)
M-4*	10.2	Manchaug St. Bridge (West of E. Douglas)
-	9.1	Hayward Woolen Co. (Div. of Einiger Corp.), E. Douglas.
- *	8.0	Above Hayward Schuster Woolen Mills, Inc.
-	7.9	Hayward Schuster Woolen Mills, Inc.
- *	7.4	Below Hayward Schuster Woolen Mills, Inc.
M-3	5.6+	Above Lackey Dam
-	5.6	Lackey Dam
- *	4.8	Whitinsville, Mass.
- *	1.2	Between Uxbridge. & No. Uxbridge, Mass.
M-2	0.5+	Above Uxbridge Dam
-	0.5	Dam at Uxbridge (above Douglas St.)

* Indicates Biological Sampling Station.

Table 1
Sampling and Reference Point Location
Blackstone & Ten Mile Rivers
August, 1964 Survey

Station Number	River Mile	Description
Blackstone River Tributaries		
Mumford River (cont.)		
-	0.5-0.4	Uxbridge Sewage
-	0.4	Emile Bernat Co., Uxbridge, Mass.
M-1 *	0.4	Depot St. Bridge , Uxbridge, Mass.
-	0.0	Mouth
West River enters Blackstone River at B-28.7		
-	3.5	U.S.G.S. Gage
-	1.7	Waucuntuck Woolen Mills, Inc., Wheelockville, Mass.
W-1*	0.6	Hecla St. Bridge, Centerville, Mass.
-	0.0	Mouth
Branch River enters Blackstone River at B-21.9		
- *	10.0	Chepachet River enters
- *	6.0	Nasonville Bridge
BR-2 *	2.6	Providence Rd. Bridge (headrace from Slatersville Reservoirs)
-	1.7	Stamina Mills , Forestdale, R. I.
-	1.6	U.S.G.S. Gage , Forestdale, R. I.
BR-1A *	1.1	Between Stamina Mills & Branch River Wool Combing Co.
-	0.9	Branch River Wool Combing Co., Branch Village, R.I.
BR-1 *	0.8	Mass. Rt. 146 Bridge, Branch Village, R. I.
-	0.0	Mouth

* Indicates Biological Sampling Station.

Table 1

Sampling and Reference Point Location
Blackstone & Ten Mile Rivers
August, 1964 Survey

Station Number	River Mile	Description
Ten Mile River		
T-9 *	19.8	Whiting Pond
	19.8-	Whiting Pond Dam
- *	19.6	Below Whiting Pond
- *	18.5	First Bridge above Coral Lake
T-8 *	16.8	Freeman St. Bridge above North Attleboro Sewage Treatment Plant.
-	15.9	North Attleboro Sewage Treatment Plant
T-7 *	15.6	Deanville Rd. Bridge
- *	13.1	Maple St. Bridge, Attleboro, Mass.
T-6A *	11.6	Tiffany St. Bridge
	11.6-	Dodgeville Pond Dam
-	11.5	Dodgeville Finishing Co.
T-6	9.3	Above Hebronville Dam
-	9.3-	Hebronville Dam
- *	9.2	Thompson Chemical Co.
-	8.3	Pond St. Bridge
T-5A	8.2	Above Attleboro Dyeing & Finishing Co. Dam
-	8.2-	Attleboro Dyeing & Finishing Co. Dam
- *	8.1	Attleboro Dyeing & Finishing Co.
		Unnamed tributary enters.
T-5 *	8.0	Above Attleboro Sewage Treatment Plant
-	7.8	Attleboro Sewage Treatment Plant
- *	7.7+	Above Mass.-Rhode Island State line.
	7.7	Mass.-Rhode Island State line.
-	7.6	Seven Mile River enters.
-	7.4+	Pawtucket Dyeing & Blackstone River intake.
-	7.4	Rhode Island-Mass. State line

* Indicates Biological Sampling Station.

Table 1
Sampling and Reference Point Location
Blackstone & Ten Mile Rivers
August, 1964 Survey

Station Number	River Mile	Description
Ten Mile River (cont.)		
-	7.2	Pawtucket Dyeing & Bleaching Co.
- *	7.15	Below Pawtucket Dyeing & Bleaching Co.
T-3 *	7.0	Mass.-Rhode Island State line - Central Ave. Bridge
T-2A	5.8+	Above Dam at Pawtucket Golf Club
-	5.8	Dam at Pawtucket Golf Club
- *	5.8-	Armistice Ave. Bridge
T-2	2.5+	East Providence Waterworks Intake - above Reservoir Dam.
-	2.5	East Providence Waterworks Dam
- *	2.2	Fall River Ave. Bridge
-*	0.8+	North Broadway St. Bridge
T-1	0.8	Roger Williams Ave. Bridge
-	0.0	Mouth (N.Y.-N.H. R.R. Bridge)
- *	8.0-0.5	Unnamed tributary to Ten Mile River.

* Indicates Biological Sampling Station.

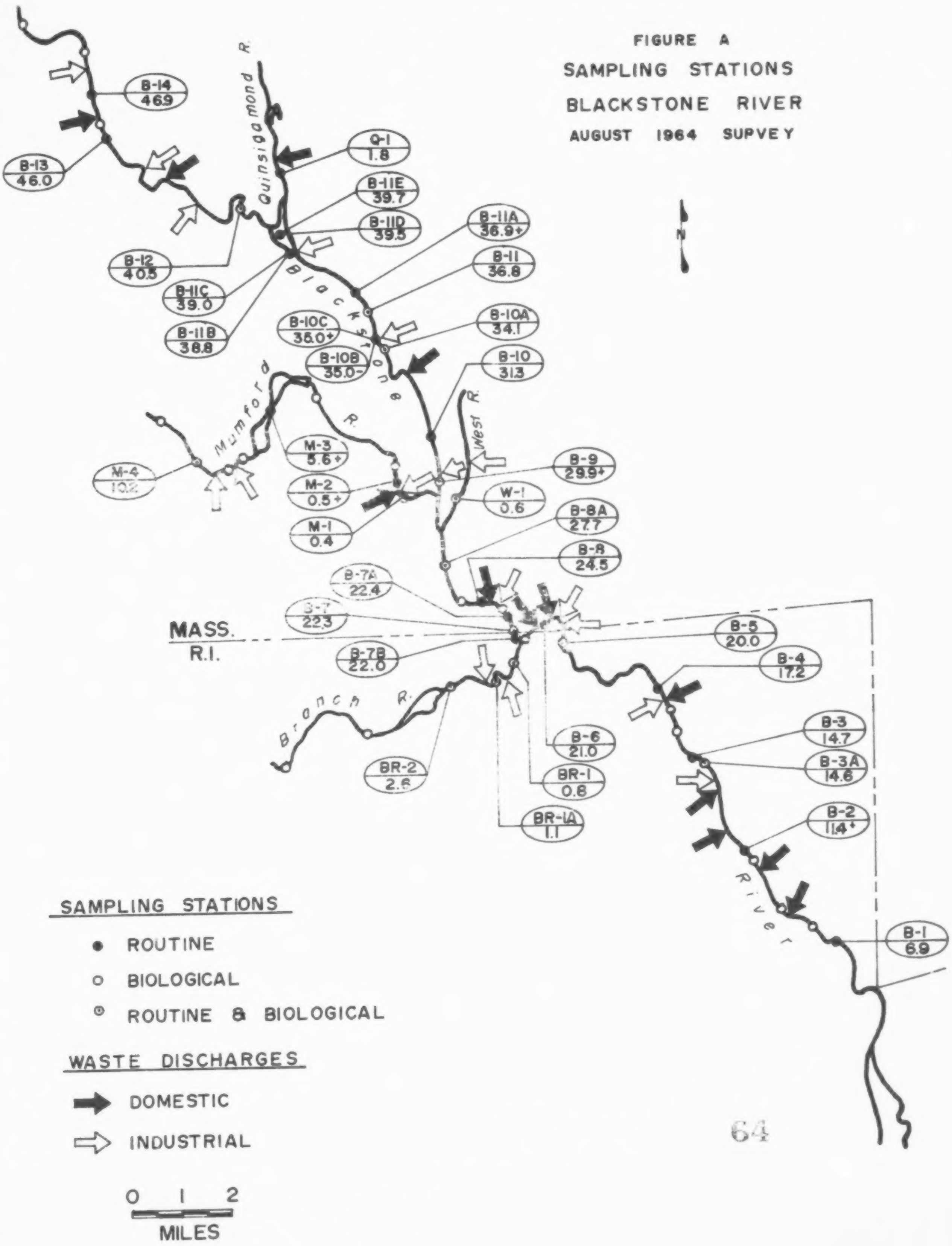

FIGURE A
SAMPLING STATIONS
BLACKSTONE RIVER
AUGUST 1964 SUPVEY

N
Quinsigamond R.
Blackstone
Mumford R.
West R.
Branch R.
River
MASS.
R.I.
B-14 46.9
B-13 46.0
Q-1 1.8
B-11E 39.7
B-11D 39.5
B-12 40.5
B-11A 36.9+
B-11 36.8
B-11C 39.0
B-11B 38.8
B-10C 36.0+
B-10A 34.1
B-10B 35.0-
B-10 31.3
M-3 5.6+
M-4 10.2
M-2 0.5+
M-1 0.4
B-9 29.9+
W-1 0.6
B-8A 27.7
B-8 24.5
B-7A 22.4
B-7 22.3
B-7B 22.0
B-5 20.0
B-4 17.2
B-6 21.0
BR-2 2.6
BR-1 0.8
BR-1A 1.1
B-3 14.7
B-3A 14.6
B-2 11.4+
B-1 6.9
SAMPLING STATIONS
● ROUTINE
○ BIOLOGICAL
⊙ ROUTINE & BIOLOGICAL
WASTE DISCHARGES
DOMESTIC
INDUSTRIAL
0 1 2
MILES

FIGURE 8

SAMPLING STATIONS
TEN MILE RIVER
AUGUST 1964 SURVEY

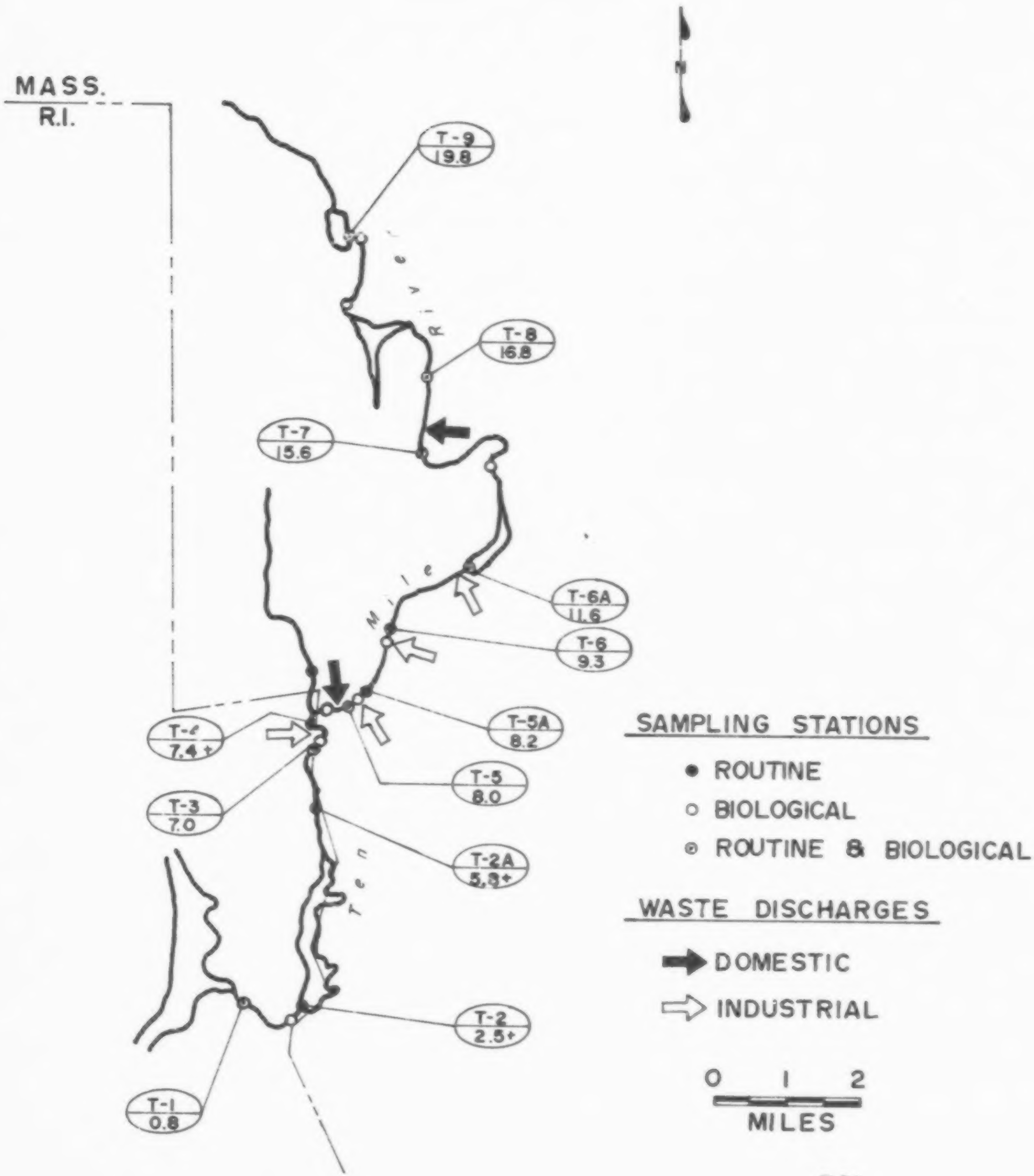
N
MASS.
R.I.
Ten Mile River
T-9 19.8
T-8 16.8
T-7 15.6
T-6A 11.6
T-6 9.3
T-5A 8.2
T-5 8.0
T-4 7.4+
T-3 7.0
T-2A 5.8+
T-2 2.5+
T-1 0.8
SAMPLING STATIONS
● ROUTINE
○ BIOLOGICAL
⊙ ROUTINE & BIOLOGICAL
WASTE DISCHARGES
DOMESTIC
INDUSTRIAL
0 1 2
MILES

Table 2
Sources of Sewage
Blackstone River
August, 1964 Survey

MUNICIPALITY	Location River Mile	Type of System 1)	TREATMENT	Population Served		ESTIMATED POPULATION EQUIVALENTS DISCHARGED					
						BACTERIAL		OXYGEN DEMAND		SUSPENDED SOLIDS	
				Number	Percent of total	Number	Percent of total	Number	Percent of total	Number	Percent of total
Massachusetts											
Worcester	46.6	SC	Secondary	180,000	76.3	90,000	64.0	40,200	43.5	48,800	49.3
Millbury	43.8 to 44.7	C	None	1,200	0.5	1,200	0.9	1,200	1.3	1,200	1.2
Grafton	39.7-2.4	*	None	1,000	0.4	1,000	0.7	1,000	1.1	1,000	1.0
Northbridge	32.4	S	Secondary	6,000	2.5	450	0.3	2,500	2.7	280	0.3
Uxbridge	29.5-0.5	*	None	500	0.2	500	0.4	500	0.5	500	0.5
Millville	24.0	*	None	400	0.2	400	0.3	400	0.4	400	0.4
Blackstone	20.5 to 21.2	*	None	500	0.2	500	0.4	500	0.5	500	0.5
	Massachusetts Total			189,600	80.3	94,050	67.0	46,300	50.0	52,680	53.2
Rhode Island											
Woonsocket	16.9	S	(See note)	45,000	19.1	45,000	32.0	45,000	48.5	45,000	45.5
Manville	14.5	S	None	700	0.3	700	0.5	700	0.8	700	0.7
Albion	12.7	C	None	300	0.1	300	0.2	300	0.3	300	0.3
Ashton	11.0	C	None	140	0.1	140	0.1	140	0.2	140	0.1
Berkeley	10.0	C	None	230	0.1	230	0.2	230	0.2	230	0.2
	Rhode Island Total			46,370	19.7	46,370	33.0	46,370	50.0	46,370	46.8
	GRAND TOTAL			235,970	100.0	140,420	100.0	92,670	100.0	99,050	100.0

Note: Woonsocket, R.I. raw sewage was bypassed directly to the river during the August, 1964 survey while additional municipal sewage treatment facilities, nearing completion, were under construction. This pollutional load will be reduced when the treatment plant is restored to full operation.

1) S = Separate sanitary sewers.
C = Combined, sanitary and storm sewers.
* = Private sewer outlets and connections to private storm drains.

Table 3
Sources of Sewage
Ten Mile River
August, 1964 Survey

MUNICIPALITY	Location River Mile	Type of System	TREATMENT	Population Served		ESTIMATED POPULATION EQUIVALENTS DISCHARGED					
						BACTERIAL		OXYGEN DEMAND		SUSPENDED SOLIDS	
				Number	Percent of total	Number	Percent of total	Number	Percent of total	Number	Percent of total
Massachusetts											
North Attleboro	15.9	S	Secondary, Sand Filters, Chlorination.	7,800	33	5	0+	840	13	380	12
Attleboro (1)	7.8	S	Sand Filters	16,000	67	2,100	100-	5,500	87	2,800	88
	Massachusetts Total			23,800	100	2,105	100	6,340	100	3,180	100

(1) Based on three total coliform and 5-day B.O.D. tests of plant effluent, during the 1964 survey, when raw sewage was applied directly to sand filters without chlorination. Suspended solids in effluent assumed to approximate one-half of B.O.D. loading. This pollutional load to the river will be reduced when trickling filters, chlorination facilities, etc., which were under construction during the survey, are completed.

Note: No severed discharged in Rhode Island section of survey area.

Table 4
Sources of Industrial Wastes
Blackstone River
August, 1964 Survey

INDUSTRY	TYPE	Location River Mile	ESTIMATED POPULATION EQUIVALENTS DISCHARGED BACTERIAL Number	Percent of total	OXYGEN DEMAND Number	Percent of total	SUSPENDED SOLIDS Number	Percent of total
Massachusetts								
The Felters Co.	Felt Dyeing	44.8	67	3.8	9,900	7.9	250	0.4
A. D. Windle Co.	1) Wool Scouring	43.7	19	1.1	700	0.6	980	1.6
W. W. Windle Co.	1) Wool Scouring	43.7	19	1.1	700	0.6	980	1.6
Snider Bros., Inc.	Meat Packing	42.1	50	2.8	300	0.2	300	0.5
J. J. O'Donnell Woolens, Inc.	Woolen Mill	38.8-	77	4.4	2,450	1.9	550	0.9
Kupfer Brothers Co.	Paper Coating Printing	35.0	47	2.7	neg.	neg.	neg.	neg.
Hayward Woolen Co. (Div. Einiger Corp.)	Wool Dyeing, Finishing	29.5-9.1	133	7.6	6,800	5.4	neg.	neg.
Hayward Schuster Woolen Mills, Inc.	Wool Dyeing, Finishing	29.5-7.9	167	9.5	12,000	9.5	6,750	11.0
Emile Bernat Co.	Wool Dyeing, Finishing	29.5-0.4	147	8.4	3,220	2.6	1,280	2.1
Stanley Woolen Co.	Wool Dyeing, Finishing	30.0	47	2.7	5,390	4.3	580	1.0
Waucantuck Mills	Wool Dyeing, Finishing	28.7-1.7	117	6.7	390	0.3	130	0.2
Blackstone Wool Co.	Scouring Alpaca, Mohair	24.3	12	0.7	270	0.2	1,050	1.7
Blackstone Potato Chip Co.	Potato Chips	20.6	15	0.9	780	0.6	960	1.5
W. & S. Laundry	Laundry	20.5	15	0.9	1,670	1.3	580	1.0
Massachusetts total			932	53.3	44,570	35.4	14,390	23.5
Rhode Island								
Stamina Mills	Wool Dyeing, Finishing	21.9-1.7	150	8.6	2,500	2.0	1,000	1.6
Branch River Wool Combing Co., Inc.	Wool Scouring	21.9-0.9	167	9.5	18,000	14.3	15,000	24.5
Woonsocket - 10 industries	Textiles, Misc.	19.8 to 16.8	477	27.3	57,400	45.5	29,900	48.8
Manville Industry	Woolen Mill	14.5	23	1.3	3,500	2.8	1,000	1.6
Rhode Island total			817	46.7	81,400	64.6	46,900	76.5
GRAND TOTAL			1,749	100.0	125,970	100.0	61,290	100.0

1) Normally operates 3 months per year (usually Sept., Dec. & Jan.)

Table 5
Sources of Organic Industrial Wastes
Ten Mile River
August, 1964 Survey

INDUSTRY	TYPE	Location River Mile	ESTIMATED POPULATION EQUIVALENTS DISCHARGED					
			BACTERIAL		OXYGEN DEMAND		SUSPENDED SOLIDS	
			Number	Percent of total	Number	Percent of total	Number	Percent of total
Massachusetts								
Dodgeville Finishing Co.	Textiles	11.5	100	31.2	2,180	6.9	Neg.	Neg.
Thompson Chemical Co.	Plastics	9.2	175	54.5	22,000	69.8	660	21.8
Attleboro Dyeing & Finishing Co.	Textiles	8.2-	30	9.3	5,600	17.8	1,720	56.8
Massachusetts total			305	95.0	29,780	94.5	2,380	78.6
Rhode Island								
Pawtucket Dyeing & Bleaching, Inc.	Textiles	7.2	16	5.0	1,730	5.5	650	21.4
Rhode Island total			16	5.0	1,730	5.5	650	21.4
GRAND TOTAL			321	100.0	31,510	100.0	3,030	100.0

TABLE 6

SOURCES OF INORGANIC INDUSTRIAL WASTES
Ten Mile River
August 1964 Survey

INDUSTRY	PRODUCT
PLAINVILLE	
Whiting & Davis Co.	Jewelry, Handbags
Plainville Stock Co.	Jewelry
A & J Tool & Findings Co.	Jewelry, Findings
NORTH ATTLEBORO	
L. G. Balfour Corp.	Jewelry
L. S. Peterson Co.	Jewelry
C. Ray Randall Manufacturing Co.	Costume Jewelry
R. Blackington & Co.	Silver Articles
General Chain Co., Inc.	Jewelry
Quaker Silver Co.	Silver Articles
Standard Metals, Inc.	Laminated Metals
C. K. Grouse Co.	School Rings
Oscar A. Hillman & Sons	Electroplated Articles
Plante & Fontaine Co.	Jewelry
Chever, Tweedy & Co.	Jewelry
ATTLEBORO	
Shields, Inc.	Jewelry
Sweet Manufacturing Co.	Jewelry
Swank, Inc.	Jewelry
Marathon Co.	Jewelry
Mis. Co.	Chain, Findings
Robbins Co.	Jewelry

TABLE 6

SOURCES OF INORGANIC INDUSTRIAL WASTES
Ten Mile River
August 1964 Survey
(Cont'd.)

INDUSTRY	PRODUCT
ATTLEBORO(cont'd.)	
Charle Thomae & Sons	Silver Articles
Antaya Brothers	Medals
Bates & Klinke	Jewelry
O. Ed Cameron & Son	Electroplated Articles
Attleboro Electroplating	Electroplated Articles
Leavens Manufacturing Co., Inc.	Jewelry
APCO Mussberg Co.	Steel Rods, Spools
Metals & Controls Corp.	Uranium Rods
Walton & Lonsbury	Electroplated Articles
Mossberg Pressed Steel	Machinery Parts
Mt. Vernon Silver Co.	Sterling Silver Articles
R. F. Simmons Co.	Jewelry
Ripley & Gowen	Jewelry
L. G. Balfour Commercial Plant	Jewelry
L. G. Balfour Co.	Jewelry

Table 7
Total Coliform
(MPN per 100 ml)
Blackstone River
August, 1964 Survey

	Station Number	River Mile	Tuesday 8-4	Wednesday 8-5	Thursday 8-6	Friday 8-7	Monday 8-10	Tuesday 8-11	Wednesday 8-12	Thursday 8-13	Friday 8-14	Monday 8-17	No. of Sampl.	Most Probable Number	Median	Average	Maximum	Minimum
Non-intercepted Sewage																		
	B-14	46.9	79,000	>1,600,000	49,300	49,000	4,900	33,000	542,000	130,000	542,000	920,000	10	143,000	104,500	394,000	>1,600,000	[illegible]
Worcester Sewage																		
	B-13	46.0	>1,600,000	90,000	1,700,000	230,000	16,000,000	9,200,000	24,000,000	7,900,000	10,900,000	13,000,000	10	8,600,000	8,550,000	8,458,000	24,000,000	50,000
Millbury Sewage																		
	B-12	40.5	1,600,000	790,000	110,000	140,000	16,000,000	16,000,000	490,000	3,300,000	3,480,000	1,720,000	10	1,600,000	1,660,000	4,363,000	16,000,000	110 000
	B-11C	38.9	-	-	-	-	-	2,400,000	330,000	16,000,000	220,000	1,300,000	5	1,200,000	1,300,000	4,050,000	16,000,000	220,000
Quinsigamond River enters																		
	B-11	36.8	140,000	33,000	170,000	79,000	49,000	330,000	490,000	1,720,000	330,000	49,000	10	165,000	155,000	339,000	1,720,000	33,000
Northbridge Sewage																		
	B-10	31.3	4,900	22,000	92,000	7,000	9,400	17,000	54,200	348,000	172,000	23,000	10	31,500	22,500	74,950	348,000	4,900
	B-9	30.0	92,000	41,000	92,000	11,000	14,000	7,900	23,000	240,000	348,000	13,000	10	41,000	32,000	88,190	348,000	7,900
Mumford & West rivers enter																		
	B-8A	27.7	-	-	-	-	540,000	130,000	130,000	87,000	94,000	22,100	6	92,000	112,000	157 200	540,000	22,100
	B-8	24.5	22,000	4,000	33,000	3,500	49,000	350,000	348,000	9,000	130,000	23,000	10	33,000	28,000	97,150	350,000	3,500
Millville Sewage																		
Mass.-Rhode Island State Line																		
	B-7	22.3	54,000	3,500	160,000	79,000	49,000	17,000	172,000	79,000	49,000	49,000	10	61,000	51,500	71,150	172,000	3,500
Branch River enters																		
Blackstone Sewage																		
Rhode Island-Mass. State Line																		
	B-6	21.0	4,300	13,000	35,000	54,000	14,000	14,000	160,000	22,100	54,200	2,100	10	21,000	18,000	37,300	160,000	2,100
Blackstone Sewage																		
Mass.-Rhode Island State Line																		
	B-5	20.0	17,000	130,000	130,000	23,000	2,200	17,000	70,000	13,000	170,000	3,300	10	28,000	20,000	57,550	170,000	2,200
Non-intercepted Woonsocket Sewers																		
	B-4	17.2	110,000	220,000	1,400,000	49,000	79,000	31,000	79,000	109,000	130,000	79,000	10	100,000	94,000	228,600	1,400,000	31,000
Woonsocket Sewage																		
	B-3	14.7	17,000,000	7,900,000	35,000,000	4,900,000	2,200,000	11,000,000	34,800,000	7,000,000	1,300,000	2,300,000	10	7,500,000	7,450,000	12,340,000	35,000,000	1,300,000
Manville Sewage																		
	B-2	11.4	220,000	79,000	2,800,000	1,100,000	110,000	230,000	230,000	240,000	1,720,000	79,000	10	865,000	230,000	630,800	2,800,000	79,000
Ashton & Berkeley Sewers																		
	B-1	6.9	280,000	79,000	540,000	330,000	3,900,000	230,000	230,000	330,000	230,000	109,000	10	260,000	255,000	585,800	3,900,000	79,000

Table 8
Total Coliform
(MPN per 100 ml)
Blackstone River Tributaries
August, 1964 Survey

	Station Number	River Mile	Tuesday 8-4	Wednesday 8-5	Thursday 8-6	Friday 8-7	Monday 8-10	Tuesday 8-11	Wednesday 8-12	Thursday 8-13	Friday 8-14	Monday 8-17	No. of Sampl.	Most Probable Number	Median	Average	Maximum	Minimum
Quinsigamond River	Q-1	B-39.7 1.8	7,900	35,000	7,900	17,000	-	-	-	-	-	-	4	-	12,450	16,950	35,000	7,900
Mumford River	M-4	B-29.5 10.2	-	1,300	7,000	230	-	-	-	-	-	-	3	-	1,300	2,840	7,000	230
Hayward (Ziniger) Woolens Hayward Schuster Woolens	M-3	5.6	-	49,000	200	2,800	-	-	-	-	-	-	3	-	2,800	17,300	49,000	200
Whitinsville & Linwood	M-2	0.5	6,300	11,000	13,000	49,000	110,000	79,000	130,000	109,000	79,000	33,000	10	44,500	64,000	61,900	130,000	6,300
Uxbridge Sewage	M-1	0.4	540,000	330,000	220,000	170,000	250,000	330,000	130,000	221,000	230,000	49,000	10	228,000	225,000	245,000	540,000	49,000
West River	W-1	B-28.7 0.6	33,000	4,900	22,000	4,900	-	-	-	-	-	-	4	-	13,450	16,200	33,000	4,900
Branch River	BR-2	B-21.9 2.6	1,700	1,700	2,800	3,300	1,700	2,800	2,200	1,300	1,300	1,700	10	1,950	1,700	2,050	3,300	1,300
Stanimac Mills Branch River Wool Combing	BR-1	0.8	13,000	49,000	49,000	130,000	33,000	49,000	109,000	49,000	33,000	172,000	10	56,000	49,000	68,600	172,000	13,000
Major Discharges																		
Worcester Sewage		46.6	-	-	-	-	-	-	840,000	-	34,800,000	10,900,000	3	-	10,900,000	15,500,000	34,800,000	840,000
Branch River Wool Combing		21.9-0.9	-	-	-	-	-	-	-	50,000	-	230,000	2	-	140,000	140,000	230,000	50,000

Table 9
Fecal Coliform
(MPN per 100 ml)
Blackstone River
August 1964 Survey

	Station Number	River Mile	Tuesday 8-4	Wednesday 8-5	Thursday 8-6	Friday 8-7	Monday 8-10	Tuesday 8-11	Wednesday 8-12	Thursday 8-13	Friday 8-14	Monday 8-17	No. of Sampl.	Most Probable Number	Median	Average	Maximum	Minimum
Non-Intercepted Sewage	B-14	46.9	4,900	1,600,000	< 2,000	< 2,000	200	1,300	33,000	7,900	13,000	33,000	10	6,200	6,400	< 170,000	1,600,000	200
Worcester Sewage	B-13	46.0	1,600,000	< 20,000	130,000	< 2,000	9,200,000	1,700,000	3,300,000	1,090,000	3,480,000	1,780,000	10	1,500,000	1,650,000	< 2,224,000	9,200,000	< 2,000
Millbury Sewage	B-12	40.5	350,000	33,000	26,000	8,000	1,100,000	310,000	50,000	490,000	460,000	170,000	10	140,000	245,000	299,700	1,100,000	8,000
	B-11C	38.9	-	-	-	-	-	790,000	130,000	460,000	23,000	172,000	5	190,000	172,000	315,000	790,000	23,000
Quinsigamond River Enters	B-11	36.8	23,000	33,000	49,000	7,000	5,000	49,000	49,000	170,000	70,000	5,000	10	26,500	41,000	46,000	170,000	5,000
Northbridge Sewage	B-10	31.5	790	3,100	4,100	4,600	1,100	2,200	7,000	49,000	24,000	1,700	10	3,400	3,600	9,760	49,000	790
	B-9	30.0	17,000	4,900	3,300	1,300	200	7,900	1,100	10,900	34,800	3,300	10	4,950	4,100	8,470	34,800	200
Mumford & West Rivers Enter	B-8A	27.7	-	-	-	-	< 2,000	1,700	700	7,000	4,600	500	6	1,850	1,700	< 2,750	7,000	500
	B-8	24.5	< 200	20	< 200	< 200	200	200	< 200	200	2,300	< 200	10	-	< 200	< 390	2,300	20
Millville Sewage Mass-R.I. State Line	B-7		1,300	3,500	92,000	22,000	200	200	700	3,300	500	200	10	1,030	1,000	12,290	92,000	200
Branch River Enters Blackstone Sewage R.I.-Mass. State Line	B-6	21.0	310	4,900	13,000	35,000	400	490	730	1,700	1,300	< 200	10	1,000	1,043	< 5,600	35,000	< 200
Blackstone Sewage Mass.-R.I. State Line	B-5	20.0	1,700	500	2,300	2,200	200	1,300	500	300	1,300	800	10	950	1,050	1,160	2,300	200
Non-Intercepted Woonsocket Sewage	B-4	17.2	49,000	220,000	170,000	33,000	23,000	23,000	17,000	14,000	13,000	33,000	10	25,000	28,000	59,500	220,000	13,000
Woonsocket Sewage	B-3	14.7	1,300,000	1,300,000	3,300,000	1,300,000	110,000	1,300,000	2,210,000	790,000	130,000	110,000	10	1,050,000	1,300,000	1,127,000	3,300,000	110,000
Manville & Albion Sewage	B-2	11.4	4,000	8,000	43,000	230,000	2,000	13,000	33,000	49,000	210,000	5,000	10	19,000	23,000	59,700	230,000	2,000
Ashton & Berkeley Sewage	B-1	6.9	3,300	3,300	13,000	22,000	2,000	2,000	4,000	11,000	17,000	5,000	10	5,800	4,500	8,260	22,000	2,000

Table 10
Fecal Coliform
(MPN per 100 ml)
Blackstone River Tributaries
August 1964 Survey

	Station Number	River Mile	Tuesday 8-4	Wednesday 8-5	Thursday 8-6	Friday 8-7	Monday 8-10	Tuesday 8-11	Wednesday 8-12	Thursday 8-13	Friday 8-14	Monday 8-17	No. of Sampl.	Most Probable Number	Median	Average	Maximum	Minimum
Quinsigamond River		B-39.7																
	Q-1	1.0	220	3,300		500	-	-	-	-	-	-	4	-	510	1,100	3,[illegible]00	220
Mumford River		B-29.5																
	M-4	10.2	-	< 20	20	60	-	-	-	-	-	-	3	-	20	< 40	[illegible]0	< 20
Hayward (Zinlager) Woolens Hayward Schuster Woolens																		
	M-3	5.6	-	< 200	< 200	50	-	-	-	-	-	-	3	-	< 200	< 150	< [illegible]00	50
Whitinsville & Linwood																		
	M-2	0.5	500	1,700	2,300	200	2,000	200	400	1,700	200	200	10	580	450	940	2,[illegible]00	200
Uxbridge Sewage																		
	M-1	0.4	130,000	170,000	70,000	110,000	79,000	79,000	49,000	23,000	79,000	49,000	10	75,000	79,000	83,600	17[illegible]	23,000
West River		B-28.7																
	W-1	0.6	13,000	1,300	2,300	2,300	-	-	-	-	-	-	4	-	2,000	5,200	13,[illegible]	2,300
Branch River		B-21.9																
	BR-2	2.6	< 200	140	80	40	20	110	80	20	< 20	20	10	55	60	< 70	1[illegible]	< 20
Stanton Mills Branch River Wool Combing																		
	BR-1	0.8	4,900	9,000	23,000	17,000	1,700	4,900	7,900	4,600	4,900	9,400	10	7,900	6,400	6,730	23,000	1,700
Major Discharges																		
Worcester Sewage		B-46.6	-	-	-	-	-	-	630,000	-	2,400,000	5,480,000	3	-	2,400,000	2,817,000	5,480,000	630,000
Branch River Wool Combing		21.9-0.9	-	-	-	-	-	-	-	< 20,000	-	3,300	2	-	> 11,650	> 11,650	< 20,000	3,300

Table 11
Total Coliform
(MPN per 100 ml)
Ten Mile River & Tributary
August, 1964 Survey

	Station Number	River Mile	Tuesday 8-4	Wednesday 8-5	Thursday 8-6	Friday 8-7	Monday 8-10	Tuesday 8-11	Wednesday 8-12	Thursday 8-13	Friday 8-14	Monday 8-17	No. of Sampl.	Most Probable Number	Median	Average	Maximum	Minimum
Ten Mile River																		
	T-9	19.8	700	3,300	7,000	1,400	-	-	-	-	-	-	4	-	3,300	3,100	7,000	700
North Attleboro Sewage Treat. Plant	T-8	16.8	1,700	7,900	22,000	23,000	350,000(1)	7,900	3,300	17,800	700	1,400	10	7,300	7,900	9,460	350,000	700
	T-7	15.6	140,000	49,000	79,000	11,000	23,000	13,000	490	4,900	3,300	2,300	10	12,800	12,000	38,000	140,000	490
	T-6A	11.6	-	-	-	-	700	330	460	490	3,300	170	6	480	475	910	3,300	170
	T-6	9.3	200	1,700	490	490	490	1,100	24,000(1)	250	1,300	940	10	730	715	770	24,000	200
	T-5A	8.2	-	-	-	-	20,000(1)	3,300	3,300	7,900	490	7,900	6	5,100	5,500	4,580	20,000	490
	T-5	8.0	>1,600,000	3,500,000	3,300,000	4,900,000	250,000	>16,000,000	92,000,000	3,300,000	34,800,000	3,300,000	10	4,950,000	3,400,000	>16,895,000	92,000,000	250,000
Attleboro Sewage Treatment Plant Mass.-Rhode Island State Line Seven Mile River enters																		
Rhode Island-Mass. State Line	T-4	7.4	>1,600,000	7,900,000	92,000,000	17,000,000	790,000	7,900,000	4,600,000	34,800,000	10,900,000	7,900,000	10	9,000,000	7,900,000	>18,539,000	92,000,000	790,000
Mass.-Rhode Island State Line	T-3	7.0	>1,600,000	7,900,000	92,000,000	13,000,000	1,300,000	13,000,000	3,300,000	7,900,000	7,000,000	4,600,000	10	6,500,000	7,450,000	>15,160,000	92,000,000	1,300,000
East Providence Waterworks Intake	T-2	2.5	500	480	2,200	4,900	1,700	24,000(1)	490	1,750	1,300	460	10	1,300	1,500	1,530	24,000	460
	T-1	0.8	33,000	17,000	49,000	33,000	-	-	-	-	-	-	4	-	33,000	33,000	49,000	17,000
Tributary																		
Seven Mile River	S-1	T-7.6 0.6	200	7,000	4,900	4,900	-	-	-	-	-	-	4	-	4,900	4,850	7,000	200
Major Discharges																		
Attleboro Sewage		7.8	-	-	-	-	-	13,000,000	-	10,900,000	4,900,000	-	3	-	10,900,000	9,600,000	13,000,000	4,900,000
North Attleboro Sewage		15.9	-	-	-	-	-	< 2,000	-	< 2,000		< 20	3	-	< 2,000	-	-	-

(1) Note: Not used in average.

Table 12
Fecal Coliform
(MPN per 100 ml)
Ten Mile River & Tributary
August 19[illegible] Survey

	Station Number	River Mile	Tuesday 8-4	Wednesday 8-5	Thursday 8-6	Friday 8-7	Monday 8-10	Tuesday 8-11	Wednesday 8-12	Thursday 8-13	Friday 8-14	Monday 8-17	No. of Sampl.	Most Probable Number	Median	Average	Maximum	Minimum
Ten Mile River																		
	T-9	19.8	200	< 200	20	< 20	-	-	-	-	-	-	4	-	< 110	< 110	200	< 20
	T-8	16.8	1,100	< 200	700	2,200	200	< 200	200	800	130	170	10	470	200	< 590	2,200	130
So. Attleboro Sewage	T-7	15.6	11,000	3,300	500	800	500	200	20	< 200	220	80	10	346	360	< 1,660	11,000	20
	T-6A	11.6	-	-	-	-	130	< 20	50	50	790	< 20	6	50	50	< 180	790	< 20
	T-6	9.3	< 200	230	50	50	80	80	230	20	1,300	80	10	100	80	< 230	1,300	20
	T-5A	8.2	-	-	-	-	< 20,000(1)	< 200	340	330	330	1,300	6	-	330	< 500	1,300	< 200
	T-5	8.0	920,000	170,000	1,300,000	170,000	50,000	700,000	13,000,000	330,000	4,900,000	330,000	10	510,000	515,000	2,187,000	13,000,000	50,000
Attleboro Sewage Treatment Plant Mass.-Rhode Island State Line Seven Mile River Enters																		
Rhode Island-Mass. State Line	T-4	7.4	>1,600,000	460,000	2,300,000	1,700,000	80,000	2,300,000	490,000	1,100,000	260,000	490,000	10	790,000	795,000	1,078,000	2,300,000	80,000
Mass.-R.I. State Line	T-3	7.0	>1,600,000	330,000	2,100,000	790,000	170,000	700,000	330,000	700,000	1,300,000	1,090,000	10	830,000	745,000	911,000	2,100,000	170,000
East Providence Water Works Intake	T-2	2.5	200	< 20	130	80	70	790	170	80	220	330	10	160	165	< 230	790	< 20
	T-1	0.8	4,900	1,700	13,000	500	-	-	-	-	-	-	4	-	3,300	5,030	13,000	500
Tributary																		
Seven Mile River		7.6																
	S-1	0.6	200	790	490	2,300	-	-	-	-	-	-	4	-	640	950	2,300	200
Major Discharges																		
Attleboro Sewage		7.8	-	-	-	-	-	3,300,000	-	2,210,000	-	790,000	3	-	2,210,000	2,100,000	3,300,000	790,000
So. Attleboro Sewage		15.9						< 2,000		< 2,000		< 20	3	-	< 2,000	< 1,340	< 2,000	< 20

Table 13
Coliform Bacteria Data Summary
Blackstone & Ten Mile Rivers

Sample Station	River Mile	No. of Samples	TOTAL COLIFORM BACTERIA Representative Conditions Most Probable								MEDIAN FECAL COLIFORM		
			Representative Conditions					Percent Samples Exceeding					
			Most Probable	Median	Average	Maximum	Minimum	1,000 MPN	2,400 MPN	5,000 MPN	MPN/100 ml	% of Median Total Coliform	Sample Station
						BLACKSTONE RIVER							
B-14	46.9	10	143,000	104,500	394,000	> 1,600,000	4,900	100	100	90	6,400	6.1	B-14
B-13	46.0	10	8,600,000	8,550,000	8,458,000	24,000,000	50,000	100	100	100	1,650,000	19.3	B-13
B-12	40.5	10	1,600,000	1,660,000	4,363,000	16,000,000	110,000	100	100	100	245,000	14.8	B-12
B-11C	38.9	5	1,200,000	1,300,000	4,050,000	16,000,000	220,000	100	100	100	172,000	13.2	B-11C
B-11	36.8	10	165,000	155,000	339,000	1,720,000	33,000	100	100	100	41,000	26.5	B-11
B-10	31.3	10	31,500	22,500	74,950	348,000	4,900	100	100	90	3,600	16.0	B-10
B-9	30.0	10	41,000	32,000	88,190	348,000	7,900	100	100	100	4,100	12.8	B-9
B-8A	27.7	6	92,000	112,000	157,200	540,000	22,100	100	100	100	1,700	1.5	B-8A
B-8	24.5	10	33,000	28,000	97,150	350,000	3,500	100	100	80	< 200	< 0.7	B-8
B-7	22.3	10	61,000	51,500	71,150	170,000	3,500	100	100	90	1,000	1.9	B-7
B-6	21.0	10	21,000	18,000	37,300	160,000	2,100	100	90	80	1,045	5.8	B-6
B-5	20.0	10	28,000	20,000	57,550	170,000	2,200	100	90	80	1,050	5.2	B-5
B-4	17.2	10	100,000	94,000	228,600	1,400,000	31,000	100	100	100	28,000	29.8	B-4
B-3	14.7	10	7,500,000	7,450,000	12,340,000	35,000,000	1,300,000	100	100	100	1,300,000	17.5	B-3
B-2	11.4	10	265,000	230,000	680,800	2,800,000	79,000	100	100	100	23,000	10.0	B-2
B-1	6.9	10	260,000	255,000	585,800	3,500,000	79,000	100	100	100	4,500	1.8	B-1
						BLACKSTONE RIVER TRIBUTARIES							
Quinsigamond River													
Q-1	1.8	4	-	12,450	16,950	35,000	7,900	100	100	100	510	4.1	Q-1
Mumford River													
M-4	10.2	3	-	1,300	2,840	7,000	230	67	33	33	20	1.5	M-4
M-3	5.6	3	-	2,800	17,300	49,000	200	67	67	33	< 200	7.1	M-3
M-2	0.5	10	44,500	64,000	61,900	130,000	6,300	100	100	100	450	9.8	M-2
M-1	0.4	10	228,000	225,000	245,000	540,000	49,000	100	100	100	79,000	20.0	M-1
West River													
W-1	0.6	4	-	13,450	16,200	33,000	4,900	100	100	50	2,800	20.8	W-1
Branch River													
BR-2	2.6	10	1,950	1,700	2,050	3,300	1,300	100	30	0	60	3.5	BR-2
BR-1	0.8	10	56,000	49,000	68,600	172,000	13,000	100	100	100	6,400	13.1	BR-1
						TEN MILE RIVER							
T-9	19.8	4	-	3,300	3,100	7,000	700	50	50	25	< 110	< 3.3	T-9
T-8	16.8	10	7,300	7,900	9,460	350,000	700	90	70	60	200	2.5	T-8
T-7	15.6	10	12,800	12,000	32,600	140,000	490	90	80	60	360	3.0	T-7
T-6A	11.6	6	480	475	910	3,300	170	17	17	0	50	10.5	T-6A
T-6	9.3	10	730	715	770	24,000	200	40	10	10	80	11.2	T-6
T-5A	8.2	6	5,100	5,500	4,580	20,000	490	83	83	50	330	6.0	T-5A
T-5	8.0	10	4,950,000	3,400,000	>16,293,000	92,000,000	230,000	100	100	100	515,000	15.1	T-5
T-4	7.4	10	9,000,000	7,900,000	>18,539,000	92,000,000	790,000	100	100	100	795,000	10.1	T-4
T-3	7.0	10	6,500,000	7,450,000	>15,160,000	92,000,000	1,300,000	100	100	100	745,000	10.0	T-3
T-2	2.5	10	1,300	1,500	1,530	24,000	460	60	20	10	185	12.3	T-2
T-1	0.8	4	-	33,000	33,000	49,000	17,000	100	100	100	3,300	10.0	T-1
						TEN MILE TRIBUTARY							
Seven Mile River													
S-1	0.6	4	-	4,900	4,250	7,000	200	75	75	25	640	13.0	S-1
						MAJOR DISCHARGES							
Worcester S.T.P. effluent		3	-	10,900,000	15,500,000	34,800,000	840,000	-	-	-	2,400,000	22.0	
Br. B. Wool Comb. Pond effluent		2	-	140,000	140,000	230,000	50,000	-	-	-	> 11,650	> 8.0	
Attleboro S.T.P. effluent		3	-	10,900,000	9,600,000	13,000,000	4,900,000	-	-	-	2,210,000	20.0	
N. Attleboro S.T.P. effluent		3	-	< 2,000	< 1,300	< 2,000	< 20	-	-	-	< 2,000	-	

TABLE 14
NUMBER OF BOTTOM ORGANISMS PER SQUARE FOOT
MARCH 1964
BLACKSTONE RIVER
MASSACHUSETTS-RHODE ISLAND

	Massachusetts						Rhode Island				
Station (River Miles) →	49-9.6	46.1	40.5	36.8	26.0	23.7	21.7	16.5	15.0	10.3+	10.3-
						SENSITIVE ORGANISMS					
KINDS											
Stoneflies - Plecoptera											
Alloperla sp.	22	-	-	-	-	-	-	-	-	-	-
Brachyptera sp.	1	-	-	-	-	-	-	-	-	-	-
Isoperla sp.	4	-	-	-	-	-	-	-	-	-	-
Mayflies - Ephemeroptera											
Stenonema sp.	2	-	-	-	-	-	-	-	-	-	-
Ephemerella sp.	6	-	-	-	-	-	-	-	-	-	-
Fishflies - Megaloptera											
Chauliodes sp.	17	-	-	-	-	-	-	-	-	-	-
Caddisflies - Tricoptera											
Polycentropus sp.	56	-	-	-	-	-	2	-	-	-	-
Cheumatopsyche sp.	19	-	-	-	-	-	-	-	-	-	-
Micrasema sp.	16	-	-	-	-	-	-	-	-	-	-
Psychomyiidae sp.	7	-	-	-	-	-	-	-	-	-	-
Neophylax sp.	1	-	-	-	-	-	-	-	-	-	-
Leptoceridae sp.	1	-	-	-	-	-	-	-	-	-	-
Riffle Beetles - Elmidae	18	-	-	-	-	-	-	-	-	-	-
Subtotal Organisms	170	0	0	0	0	0	2	0	0	0	0
Subtotal Kinds	13	0	0	0	0	0	1	0	0	0	0
						INTERMEDIATE ORGANISMS					
Water Scavenger Beetles - Hydrophilidae											
Berosus sp.	-	-	-	-	-	1	-	-	-	-	-
Black Flies - Simuliidae	336	-	-	-	-	-	-	-	-	-	-
Midges - Tendipedidae[1]	140	-	-	-	1	-	22	-	-	-	-
Crane Flies - Tipulidae											
Antocha sp.	9	-	-	-	-	-	-	-	-	-	-
Tipula sp.	3	-	-	-	-	-	2	-	-	-	-
Roundworms - Nematoda	-	-	-	-	-	-	-	-	-	-	-
Scuds - Amphipoda											
Hyalella sp.	121	-	-	-	-	-	9	-	-	-	-
Fingernail Clams - Pelecypoda	16	-	-	-	-	-	-	-	-	-	-
Snails - Gastropoda											
Physa sp.	-	-	-	-	-	-	2	-	-	-	-
Limpets - Gastropoda											
Ferrissia sp.	-	-	-	-	-	-	1	-	-	-	-
Unidentified	1	-	-	-	-	-	-	-	7	-	-
Subtotal Organisms	626	0	0	0	1	1	36	0	7	0	0
Subtotal Kinds	7	0	0	0	1	1	5	0	1	0	0
						TOLERANT ORGANISMS					
Leeches - Hirudinea	-	-	-	-	10	3	39	-	-	-	-
Sludgeworms - Tubificidae	-	6,972	16,800	19,488	562	2,522	6	2,836	3	385	1,176
Bloodworms - Tendipedidae[2]	-	-	-	-	9	1	1	-	-	17	-
Subtotal Organisms	0	6,972	16,800	19,488	581	2,526	46	2,836	3	403	1,176
Subtotal Kinds	0	1	1	1	3	3	3	1	1	3	1
Grand Total Organisms	796	6,972	16,800	19,488	582	2,527	84	2,836	10	403	1,176
Grand Total Kinds	20	1	1	1	4	4	9	1	2	3	1

1 - Tendipedidae larvae without ventral blood gills.

2 - Tendipedidae larvae with ventral blood gills.

TABLE 15

NUMBER OF BOTTOM ORGANISMS PER SQUARE FOOT

BLACKSTONE RIVER

AUGUST, 1964

MASSACHUSETTS - RHODE ISLAND

	Massachusetts								State Line Area		Rhode Island			
Station (River Miles) ⟶	47.9	46.1	40.5	36.8	34.1	29.9	27.7	23.7	22.0	21.7	20.0	14.6	11.3	7.9
KINDS														
						NO SENSITIVE ORGANISMS								
						INTERMEDIATE ORGANISMS								
Midges - Tendipedidae[1]	-	-	-	134	6	1.792	213	179	50	318	2	3,792	947	736
Black Flies - Simulidae	-	-	-	2	2	23	3	1	-	38	-	768	3	32
Phantom Midges - Culicidae Chaoborus sp.	-	-	-	-	-	-	-	-	-	-	11	-	-	-
Crane Flies - Tipulidae														
Antocha sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tipula sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Roundworms - Nematoda	-	-	-	-	-	-	19	2	3	26	-	14	107	4
Flatworms - Turbellaria	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Scuds - Amphipoda														
Hyalella sp.	-	-	-	-	2	-	-	-	-	-	-	3	-	38
Sowbugs - Isopoda														
Asellus sp.	-	-	-	-	-	-	-	-	-	-	-	-	4	5
Fingernail Clams - Pelecypoda														
Sphaeridae	-	-	-	-	-	-	5	-	-	-	-	-	-	-
Snails - Gastropoda	-	-	-	-	3	3	3	4	3	6	-	4	3	2
Limpets - Gastropoda	-	-	-	-	-	-	-	-	-	-	-	-	40	9
Subtotal Organisms	0	0	0	136	13	1,818	243	186	56	388	13	4.581	1.104	828
Subtotal Kinds	0	0	0	2	4	3	5	4	3	4	2	5	6	8
						TOLERANT ORGANISMS								
Leeches - Hirudinea	-	-	-	-	85	50	74	27	26	6	-	48	59	51
Midges - Tendipedidae[2]	-	-	-	-	205	-	277	44	-	-	-	464	122	166
Sludgeworms - Tubificidae	20,352	3,645	55,808	4,454	3,731	1,805	187	3,193	6	70	-	23.040	230	1.178
Subtotal Organisms	20,352	3,645	55,808	4,454	4,021	1,855	538	3,264	32	76	0	23.552	411	1 395
Subtotal Kinds	1	1	1	1	3	2	3	3	2	2	0	3	3	3
Grand Total Organisms	20,352	3,645	55,808	4,590	4,034	3,673	781	3,450	88	464	13	28.133	1.515	2.222
Grand Total Kinds	1	1	1	3	7	5	8	7	5	6	2	8	9	11

1 - Tendipedidae larvae without ventral blood gills.

2 - Tendipedidae larvae with ventral blood gills.

TABLE 16

NUMBER OF BOTTOM ORGANISMS PER SQUARE FOOT
MARCH 1964
TRIBUTARY STREAMS TO THE BLACKSTONE RIVER
MASSACHUSETTS-RHODE ISLAND

	MUMFORD RIVER			WEST RIVER	CHEPACHET R.	BRANCH RIVER		
Station (River Miles) →	29-11.6	29-7.4	29-1.2	28-0.6	22-10.0	22-6.0	22-2.6	22-0.8
				SENSITIVE ORGANISMS				
KINDS								
Stoneflies - Plecoptera								
Acroneuria sp.	-	-	-	-	3	-	-	-
Isoperla sp.	5	-	-	-	2	-	-	-
Alloperla sp.	2	-	-	-	-	-	-	-
Brachyptera sp.	2	-	-	-	-	-	-	-
Mayflies - Ephemeroptera								
Stenonema sp.	11	-	-	-	15	-	-	-
Ephemerella sp.	-	-	-	-	10	-	-	-
Fishflies - Megoloptera								
Chauliodes sp.	3	-	-	-	2	-	-	-
Alderflies - Megoloptera								
Sialis sp.	-	-	-	-	3	-	-	-
Caddisflies - Tricoptera								
Cheumatopsyche sp.	23	-	37	-	3	29	1	-
Hydropsyche sp.	20	-	-	-	2	-	1	-
Chimarra sp.	14	-	-	-	-	-	-	-
Polycentropus sp.	-	-	-	-	11	-	-	-
Ptilostomis sp.	-	-	-	-	3	-	-	-
Rhyacophila sp.	5	-	-	-	-	-	-	-
Glossosoma sp.	1	-	-	-	-	-	-	-
Unidentified sp.	-	-	-	-	3	-	-	-
Water Penny - Psephenidae								
Psephenus sp.	2	-	-	-	3	-	-	-
Dryopids - Dryopidae								
Helichus sp.	-	-	-	2	1	-	-	-
Subtotal Organisms	88	0	37	2	61	29	1	0
Subtotal Kinds	11	0	1	1	13	1	1	0
				INTERMEDIATE ORGANISMS				
Black Flies - Simulidae	199	-	-	-	-	59	2	-
Midges - Tendipedidae[1]	3	-	30	111	22	7	1	-
Snipe Flies - Rhagionidae								
Atherix sp.	-	-	-	-	3	-	-	-
Crane Flies - Tipulidae								
Antocha sp.	1	-	-	-	-	-	-	-
Damselflies - Zygoptera								
Agrion sp.	-	-	-	-	1	-	-	-
Planaria - Turbellaria	-	-	-	2	-	7	-	-
Scuds - Amphipoda								
Hyalella sp.	-	-	-	-	3	28	-	-
Sowbugs - Isopoda								
Asellus sp.	-	-	2	2	-	2	2	-
Crawfish - Decapoda	-	-	-	-	-	1	-	-
Fingernail Clams - Pelecypoda	1	-	-	17	1	-	-	-
Operculate Snails - Gastropoda	-	-	-	2	-	-	-	-
Limpets - Gastropoda								
Ferrissia sp.	-	-	-	7	-	1	-	-
Subtotal Organisms	204	0	32	141	30	105	5	0
Subtotal Kinds	4	0	2	6	5	7	3	0
				TOLERANT ORGANISMS				
Leeches - Hirudinea	-	-	-	18	-	7	-	-
Bloodworms - Tendipedidae[2]	-	-	-	44	-	-	-	-
Sludgeworms - Tubificidae	-	-	5	20	-	5	1	15
Subtotal Organisms	0	0	5	82	0	12	1	15
Subtotal Kinds	0	0	1	3	0	2	1	1
Grand Total Organisms	292	0	74	225	91	146	7	15
Grand Total Kinds	15	0	4	10	18	10	5	1

1 - Tendipedidae larvae without ventral blood gills.

2 - Tendipedidae larvae with ventral blood gills.

TABLE 17

NUMBER OF ORGANISMS PER SQUARE FOOT
TRIBUTARIES TO THE BLACKSTONE RIVER

AUGUST, 1964

MASSACHUSETTS - RHODE ISLAND

	RHODE ISLAND					MASSACHUSETTS					
Station (River Miles) ———>	CHEPACHET R.	BRANCH R.				WEST R.	MUMFORD R.				
	22-10.0	22-6.0	22-2.6	22-1.1	22-0.8	28-0.6	29-10.2	29-7.9	29-7.4	29-1.2	29-0.4
KINDS											
SENSITIVE ORGANISMS											
Stoneflies - Plecoptera											
Brachyptera sp.	-	-	-	-	-	-	1	-	-	-	-
Mayflies - Ephemeroptera											
Caenis sp.	2	-	-	-	-	-	-	-	-	-	-
Stenonema sp.	-	-	4	-	-	-	33	-	-	-	-
Tricorythoides sp.	-	-	1	-	-	-	-	-	-	-	-
Ameletus sp.	2	25	-	-	-	-	1	-	-	-	-
Heptagenia sp.	2	-	-	-	-	-	-	-	-	-	-
Alder - and Fishflies - Megoloptera											
Sialis sp.	-	-	-	-	-	-	-	-	-	-	-
Corydalus sp.	-	-	-	-	-	-	2	-	-	-	-
Caddisflies - Trichoptera											
Cheumatopsyche sp.	-	666	44	-	-	-	32	-	-	5	14
Hydropsyche sp.	-	18	12	-	-	-	40	-	-	-	-
Polycentropus sp.	19	-	-	-	-	-	-	-	-	-	-
Leucotrichia sp.	-	-	5	-	-	-	-	-	-	-	-
Water Pennies - Psephenidae											
Psephenus sp.	6	-	-	-	-	-	-	-	-	-	-
Riffle Beetles - Coleoptera											
Elmidae	3	-	1	-	-	-	32	-	-	-	-
Subtotal Organisms	34	709	67	0	0	0	141	0	0	5	14
Subtotal Kinds	6	3	6	0	0	0	7	0	0	1	1
INTERMEDIATE ORGANISMS											
Scavenger Beetles - Hydrophilidae											
Berosus sp.	-	-	-	-	-	-	-	-	-	2	13
Midges - Tendipedidae[1]	107	3,590	440	29	2	144	75	602	-	458	89
Biting Midges - Ceratopogonidae											
Palpomyia sp.	2	-	-	-	-	-	-	-	-	-	-
Blackflies - Simulidae	3	100	6	6	-	-	1	-	-	2	2
Craneflies - Tipulidae											
Antocha sp.	2	-	-	-	-	-	3	-	-	-	-
Roundworms - Nematoda	2	4	-	6	-	16	-	58	-	26	12
Flatworms - Turbellaria	2	428	9	-	-	-	9	-	-	-	-
Scuds - Amphipoda											
Hyalella sp.	-	-	2	-	-	-	-	-	-	-	-
Sowbugs - Isopoda											
Asellus sp.	-	-	67	-	-	-	1	6	-	16	-
Crayfish - Decapoda	-	-	-	-	-	-	-	-	-	-	-
Fingernail Clams - Pelecypoda											
Sphaeridae	-	42	49	-	-	3	-	-	-	-	262
Mussels - Unionidae	-	-	-	-	-	-	-	-	-	-	-
Snails - Gastropoda	-	-	21	3	-	3	31	-	-	2	538
Limpets - Gastropoda	29	-	-	-	-	-	-	5	-	-	307
Dance Flies - Empididae	-	28	4	-	-	-	-	-	-	-	-
Subtotal Organisms	147	4,192	598	44	2	166	120	671	0	506	1,223
Subtotal Kinds	7	6	8	4	1	4	6	4	0	6	7
TOLERANT ORGANISMS											
Leeches - Hirudinea	-	25	15	-	-	13	-	8	-	24	32
Midges - Tendipedidae[2]	-	-	8	-	-	-	-	-	-	13	45
Sludgeworms - Tubificidae	-	4	5	138	8	122	-	128	13	155	154
Subtotal Organisms	0	29	28	138	8	135	0	136	13	192	231
Subtotal Kinds	0	2	3	1	1	2	0	2	1	3	3
Grand Total Organisms	181	4,930	693	182	10	301	261	807	13	703	1,468
Grand Total Kinds	13	11	17	5	2	6	13	6	1	10	11

[1] - Tendipedidae larvae without ventral blood gills.

[2] - Tendipedidae larvae with ventral blood gills.

TABLE 18

NUMBER OF BOTTOM ORGANISMS PER SQUARE FOOT
MARCH 1964
Ten Mile RIVER
MASSACHUSETTS-RHODE ISLAND

Station(River Miles) →	19.6	18.5	16.8	15.6	13.1	11.6	9.2	8.1	8.0	7.7	7.0	5.8-	2.2	0.8+
	Massachusetts										Rhode Island			
							SENSITIVE ORGANISMS							
KINDS														
Alderflies - Megaloptera *Sialis* sp.	-	-	2	-	-	-	-	-	-	-	-	-	-	-
Caddisflies - Tricoptera *Cheumatopsyche* sp.	2	-	-	-	-	-	-	-	-	-	-	-	-	-
Subtotal Organisms	2	0	2	0	0	0	0	0	0	0	0	0	0	0
Subtotal Kinds	1	0	1	0	0	0	0	0	0	0	0	0	0	0
							INTERMEDIATE ORGANISMS							
Midges - Tendipedidae[1]	13	2	101	-	-	-	487	-	4	-	-	25	336	-
Biting Midges - Ceratopogonidae *Palpomyia* sp.	-	-	2	-	-	-	-	-	-	-	-	-	-	-
Roundworms - Nematoda	5	-	-	-	-	3	-	-	-	-	-	22	7	-
Scuds - Amphipoda *Hyalella* sp.	-	-	-	-	-	-	-	-	-	-	-	-	7	62
Sowbugs - Isopoda *Asellus* sp.	-	-	-	-	-	-	-	-	-	-	-	-	8	3
Fingernail Clams - Pelecypoda	-	-	-	-	-	-	-	-	-	-	-	-	2	-
Snail - Gastropoda *Physa* sp.	-	-	-	-	-	-	-	-	-	-	-	-	2	-
Planaria - Turbellaria	-	-	-	-	-	-	-	-	-	-	-	-	108	-
Subtotal Organisms	18	2	103	0	0	3	487	0	4	0	0	47	470	65
Subtotal Kinds	2	1	2	0	0	1	1	0	1	0	0	2	7	2
							TOLERANT ORGANISMS							
Leeches - Hirudinea	-	-	-	-	-	-	-	-	-	-	-	27	12	-
Midges - Tendipedidae[2]	-	-	7	108	2	-	706	328	8	192	2	2	101	-
Rat-tailed Maggots - Syrphidae *Tubifera* sp.	-	-	-	-	-	-	-	-	-	4	-	-	-	-
Sludgeworms - Tubificidae	81	-	2	9,408	420	3	-	460	24	1,680	462	-	175	2
Subtotal Organisms	81	0	9	9,516	422	3	706	788	32	1,876	464	29	288	2
Subtotal Kinds	1	0	2	2	2	1	1	2	2	3	2	2	2	1
Grand Total Organisms	101	2	114	9,516	422	6	1,193	788	36	1,876	464	76	758	67
Grand Total Kinds	4	1	5	2	2	2	2	2	3	3	2	4	9	3

1 - Tendipedidae larvae without ventral blood gills.

2- Tendipedidae larvae with ventral blood gills.

TABLE 19
NUMBER OF BOTTOM ORGANISMS PER SQUARE FOOT
TEN MILE RIVER
AUGUST, 1964
MASSACHUSETTS - RHODE ISLAND

	Massachusetts								State Line Area		Rhode Island	
Station (River Miles) ⟶	19.8	16.8	15.6	13.1	9.2	8.1	8.0	7.7	7.15	7.0	5.8	2.2
KINDS												
SENSITIVE ORGANISMS												
Alderflies - Megaloptera												
Chauliodes sp.	-	6	-	-	-	-	-	-	-	-	-	-
Caddisflies - Trichoptera												
Cheumatopsyche sp.	38	-	-	-	-	-	-	-	-	-	-	-
Trentonius sp.	6	-	-	-	-	-	-	-	-	-	-	-
Riffle Beetles - Coleoptera												
Elmidae	13	-	-	-	-	-	-	-	-	-	-	-
Subtotal Organisms	57	6	0	0	0	0	0	0	0	0	0	0
Subtotal Kinds	3	1	0	0	0	0	0	0	0	0	0	0
INTERMEDIATE ORGANISMS												
Scavenger Beetles - Hydrophilidae												
Berosus sp.	6	-	-	-	-	-	-	-	-	-	-	-
Midges - Tendipedidae[1]	1,073	90	1,382	90	154	538	51	38	-	258	4,265	2,099
Biting Midges - Ceratopogonidae												
Palpomyia sp.	-	38	-	-	6	-	-	-	-	-	-	-
Damselflies - Zygoptera												
Agrion sp.	-	-	-	-	12	-	-	-	-	-	-	-
Blackflies - Simulidae	32	-	-	-	-	-	-	-	-	-	26	22
Roundworms - Nematoda	-	-	-	-	19	128	26	-	6	-	154	18
Flatworms - Turbellaria	7	-	-	-	-	-	-	-	-	-	-	19
Scuds - Amphipoda												
Hyalella sp.	-	-	-	-	-	-	-	-	-	-	-	1,024
Sowbugs - Isopoda												
Asellus sp.	-	-	-	3	13	-	-	-	-	-	-	17
Fingernail Clams - Pelecypoda												
Sphaeridae	32	-	-	-	-	-	-	-	-	-	-	5
Snails - Gastropoda	6	-	-	-	-	-	-	-	-	-	-	4
Subtotal Organisms	1,156	128	1 382	93	204	666	77	38	6	258	4,445	3,208
Subtotal Kinds	6	2	1	2	5	2	2	1	1	1	3	8
TOLERANT ORGANISMS												
Leeches - Hirudinea	-	-	-	-	-	-	-	-	-	-	128	51
Midges - Tendipedidae[2]	6	-	11,059	22	6	1,433	51	-	256	307	154	205
Sludgeworms - Tubificidae	499	-	11,016	140	19	1,741	3,405	64	614	8,243	51	8.653
Subtotal Organisms	505	0	22,075	162	25	3,174	3,456	64	870	8,550	333	8,909
Subtotal Kinds	2	0	2	2	2	2	2	1	2	2	3	2
Grand Total Organisms	1,718	134	23,457	255	229	3,840	3,533	102	876	8,808	4.778	12,117
Grand Total Kinds	11	3	3	4	7	4	4	2	3	3	6	11

1 - Tendipedidae larvae without ventral blood gills.

2 - Tendipedidae larvae with ventral blood gills.

Table 20
Biochemical Oxygen Demand (2 & 5 Days)
(Values in mg/l)
Blackstone River
August, 1964 Survey

	Station Number	River Mile	Tuesday 8-4		Wednesday 8-5		Thursday 8-6		Friday 8-7		Monday 8-10		Tuesday 8-11		Wednesday 8-12		Thursday 8-13		Friday 8-14		Monday 8-17		No. of Samples		Average		Maximum		Minimum	
			2-day	5-day	2-day	5-day	2-day	5-day	2-day	5-day	2-day	5-day	2-day	5-day	2-day	5-day	2-day	5-day	2-day	5-day	2-day	5-day	2-day	5-day	2-day	5-day	2-day	5-day	2-day	5-d
Non-intercepted sewage & indus. waste																														
	B-14	46.9	-	13.4	-	4.8	3.1	6.4	-	3.3	-	5.6	-	-	-	6.5	-	-	-	5.5	-	-	1	7	3.1	6.5	3.1	13.4	3.1	3.
Worcester sewage treatment pl. effluent																														
	B-13	46.0	>6.4	27.4	14.6	28.4	10.6	19.4	9.7	16.8	20.6	40.8	-	-	18.6	36.5	-	-	8.0	18.6	-	-	7	7	>12.6	26.8	20.6	40.8	>6.4	16.
Felters Co., Millbury sewers, & Saisser Packing																														
	B-12	40.5	-	10.2	-	3.6	1.1	5.9	-	3.0	-	20.8	-	-	-	4.5	-	-	-	10.1	-	-	1	7	1.1	8.3	1.1	20.8	1.1	3.
J. J. O'Donnel																														
	B-11C	38.9	-	-	-	-	-	-	-	-	-	-	-	-	-	5.6	-	-	-	6.8	-	-	0	2	-	6.2	-	6.8	-	5.
Quinsigamond River enters																														
	B-11	36.8	3.0	9.5	-	12.6	3.6	9.3	2.4	6.8	2.8	7.8	-	-	3.7	9.8	10.2	15.1	3.6	8.7	-	-	7	8	4.2	10.0	10.2	15.1	2.4	6.
Kupfer Co. enters Northbridge sewage treatment plant effluent																														
	B-10	31.3	-	10.2	-	7.3	3.1	7.3	-	5.2	-	4.2	-	-	-	4.0	-	-	-	6.1	-	-	1	7	3.1	6.3	3.1	10.2	3.1	4.
Stanley Woolen Co.																														
	B-9	30.0	10.3	19.6	4.2	10.1	5.8	11.4	7.2	12.4	4.3	7.8	-	-	11.2	17.0	-	-	3.0	9.3	-	-	7	7	6.6	12.5	11.2	19.6	3.0	7.
Mumford & West rivers enter																														
	B-8A	27.7	-	-	-	-	-	-	-	-	-	4.3	-	-	-	5.8	-	-	-	6.8	-	-	0	3	-	5.6	-	6.8	-	4.
	B-8	24.5	-	2.8	-	3.2	1.7	3.7	-	2.6	-	2.3	-	-	-	2.2	-	-	-	-	-	-	1	6	1.7	2.8	1.7	3.7	1.7	2.
Blackstone Wool & Millville sewage Mass.-Rhode Island State line																														
	B-7	22.3	1.4	3.8	1.4	3.2	2.4	4.7	1.5	3.6	1.0	2.7	0.5	1.6	0.7	2.0	1.8	5.1	1.1	5.1	0.9	2.5	10	10	1.3	3.4	2.4	5.1	0.5	1.
Branch River enters & Blackstone sewage Rhode Island-Mass. State line																														
	B-6	21.0	-	13.2	-	11.1	6.4	17.7	-	20.4	-	5.5	-	10.0	-	15.9	-	19.1	-	6.1	-	6.0	1	10	6.4	11.8	6.4	17.7	6.4	5.
Blackstone Sewage & industrial waste Mass.-Rhode Island State line																														
	B-5	20.0	-	15.9	-	>16.1	-	16.0	-	10.6	-	5.8	-	4.4	-	11.8	-	13.2	-	7.5	-	4.5	0	10	-	>10.6	-	16.0	-	4.
Non-intercepted Woonsocket sewage and industrial waste																														
	B-4	17.2	-	22.2	-	13.3	5.9	9.7	-	8.6	-	10.0	-	-	-	6.4	-	-	-	7.5	-	-	1	7	5.9	11.1	5.9	22.2	5.9	6.
Woonsocket sewage & industrial waste																														
	B-3	14.7	6.8	12.9	13.5	22.7	9.6	18.2	-	-	4.3	13.5	-	-	3.6	13.4	-	-	2.2	7.7	-	-	6	6	6.7	14.7	13.5	22.7	2.2	7.
Manville sewage & industrial waste																														
	B-2	11.4	-	5.2	-	5.8	5.1	12.1	-	8.7	-	>16.8	-	-	-	-	-	-	-	-	-	-	1	5	5.1	>9.7	5.1	12.1	5.1	5.
Ashton & Berkeley sewers																														
	B-1	6.9	-	4.4	-	4.9	3.6	9.5	-	9.4	-	>16.8	-	-	-	-	-	-	-	-	-	-	1	5	3.6	>9.0	3.6	9.5	3.6	4.

Table 21
Biochemical Oxygen Demand (2 & 5 Day)
(Values in mg/l)
Blackstone River Tributaries
August, 1964 Survey

	Station Number	River Mile	Tuesday 8-4		Wednesday 8-5		Thursday 8-6		Friday 8-7		Monday 8-10		Tuesday 8-11		Wednesday 8-12		Thursday 8-13		Friday 8-14		Monday 8-17		No. of Samples		Average		Maximum		Minimum	
			2-day	5-day	2-day	5-day	2-day	5-day	2-day	5-day	2-day	5-day	2-day	5-day	2-day	5-day	2-day	5-day	2-day	5-day	2-day	5-day	2-day	5-day	2-day	5-day	2-day	5-day	2-day	5-day
Quinsigamond River		B-39.7																												
	Q-1	1.8	-	4.1	-	4.8	2.5	5.3	-	6.5	-	-	-	-	-	-	-	-	-	-	-	-	1	4	2.5	5.2	2.5	6.5	2.5	4.1
Mumford River		B-29.5																												
	M-4	10.2	-	-	-	0.2	0.7	1.4	-	1.0	-	-	-	-	-	-	-	-	-	-	-	-	1	3	0.7	0.9	0.7	1.4	0.7	0.2
Hayward (Kininger) Woolens Hayward Schuster Woolens	M-3	5.9	-	-	-	13.1	5.1	8.1	-	9.4	-	-	-	-	-	-	-	-	-	-	-	-	1	3	5.1	10.2	5.1	[illegible]	5.1	[illegible]
Whitinsville & Linwood	M-2	3.5	-	4.7	-	3.8	2.8	5.0	-	4.4	-	5.6	-	-	-	-	-	-	-	-	-	-	1	5	2.8	4.7	2.8	5.6	2.8	3.8
Emile Bernat	M-1	0.4	7.4	13.0	7.4	15.6	9.2	16.4	6.4	12.2	4.1	8.8	-	-	6.6	9.7	-	-	1.2	7.4	-	-	7	7	6.0	11.9	9.2	16.4	1.2	7.4
West River		B-28.7																												
Waucantuck Woolen Mill	W-1	0.6	-	9.0	-	10.9	-	1.2	-	2.4	-	-	-	-	-	-	-	-	-	-	-	-	0	4	-	5.9	-	10.9	-	1.2
Branch River		B-21.9																												
	BR-2	2.6	-	3.4	-	3.0	1.7	3.1	-	3.1	-	3.4	-	3.3	-	-	-	3.6	-	3.5	-	5.0	1	9	1.7	3.5	1.7	5.0	1.7	3.0
Stamina Mills Branch River Wool Combing	BR-1	0.8	38.9	88.6	34.6	78.2	39.9	86.0	-	-	38.8	57.2	-	42.4	14.8	128.8	44.0	60.8	3.6	13.6	127.5	240.4	8	9	42.8	88.4	127.5	240.4	3.6	13.6
Major Discharges																														
Branch River Wool Combing Co.		21.9-0.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,825	4,075	-	-	-	10,275	1	8	1,825	7,185	1,825	10,275	1,825	4,6[illegible]
Worcester Sewage Treatment Plant		46.6	-	-	-	-	-	-	-	-	-	-	-	-	-	36.6	-	-	-	69.9	-	59.5	0	3	-	53.0	-	69.9	-	36.6

Table 22
Biochemical Oxygen Demand (2 & 5 Day)
(Values in mg/l)
Ten Mile River
August, 1964 Survey

	Station Number	River Mile	Tuesday 8-4		Wednesday 8-5		Thursday 8-6		Friday 8-7		Monday 8-10		Tuesday 8-11		Wednesday 8-12		Thursday 8-13		Friday 8-14		Monday 8-17		No. of Samples		Average		Maximum		Minimum	
			2-day	5-day	2-day	5-day	2-day	5-day	2-day	5-day	2-day	5-day	2-day	5-day	2-day	5-day	2-day	5-day	2-day	5-day	2-day	5-day	2-day	5-day	2-day	5-day	2-day	5-day	2-day	5-
Whiting Pond	T-9	19.8	-	6.5	-	5.0	7.3	>8.5	-	4.2	-	-	-	>8.6	-	-	-	-	-	-	-	-	1	5	7.3	>6.6	7.3	6.5	7.3	4
	T-8	16.8	-	2.8	-	3.7	2.2	4.2	-	3.2	-	-	-	7.0	-	-	-	5.0	-	-	-	4.1	1	7	2.2	4.3	2.2	7.0	2.2	2
E. Attleboro Sewage Treatment Plant																														
	T-7	15.6	-	9.5	-	10.6	4.6	9.5	-	7.4	-	-	-	7.1	-	-	-	6.9	-	-	-	5.3	1	7	4.6	9.1	4.6	10.6	4.6	5
	T-6A	11.6	-	-	-	-	-	-	-	-	-	-	-	10.9	-	-	-	10.6	-	-	-	-	0	2	-	10.8	-	10.9	-	10
Dodgeville Finishing Co.																														
	T-6	9.3	-	9.2	-	13.9	7.5	13.3	-	12.8	-	-	-	13.4	-	-	-	11.6	-	-	-	12.8	1	7	7.5	12.4	7.5	13.9	7.5	9
Thompson Chemical Co.																														
	T-5A	8.2	-	-	-	-	-	-	-	-	-	46.2	-	14.3	-	22.6	-	23.9	-	29.4	-	18.7	0	6	-	25.8	-	46.2	-	14
Attleboro Dyeing & Finishing																														
	T-5	8.0	-	45.6	-	46.6	-	25.8	-	24.2	-	18.0	-	36.2	-	53.8	-	20.4	-	28.8	-	19.5	0	10	-	31.9	-	53.8	-	12
Attleboro STP; Mass.-R.I. State Line; Seven Mile River Enters																														
	T-4	7.4	-	>50.0	-	17.9	-	22.4	-	18.6	-	28.9	-	22.4	-	20.4	-	22.8	-	-	-	18.2	0	9	-	>25.7	-	28.9	-	17
Rhode Island-Mass. State Line Pawtucket Dyeing & Bleaching																														
Mass.-Rhode Island State Line	T-3	7.0	-	>50.0	-	11.3	-	20.1	-	21.9	-	-	-	31.8	-	16.4	-	21.4	-	15.2	-	29.2	0	9	-	>22.1	-	31.8	-	11
	T-2	2.5	3.2	7.2	-	6.9	5.2	7.9	-	6.1	-	-	-	5.8	-	-	-	7.6	-	-	-	8.1	2	7	4.2	7.1	5.2	8.1	3.2	5
	T-1	0.8	-	>7.8	-	>7.8	4.0	7.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	4	4.0	>7.7	4.0	8.2	4.0	7
Tributary																														
Seven Mile River	S-1	7.6 7.6-0.6	-	1.6	-	5.5	2.0	3.1	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	1	4	2.0	3.1	2.0	5.5	2.0	1
Major Discharges & Special Samples																														
	T-5A Filtered		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12.8	-	-	-	9.2	0	2	-	11.0	-	12.8	-	9
Attleboro Sewage Treatment Plant		7.8	-	-	-	-	-	-	-	-	-	-	-	46.0	-	-	-	54.0	-	-	-	70.6	0	3	-	56.9	-	70.6	-	46
No. Attleboro Sewage Treatment Plant		15.9	-	-	-	-	-	-	-	-	-	-	-	3.2*	-	-	-	*	-	-	-	*	0	3	-	*	-	*	-	

*Note: Too much chlorine in waste for test to be accurate.

Table 23
Dissolved Oxygen
(in mg/1)
Blackstone River
Aug. 1964 Survey

	Station Number	River Mile	Tues. 8-4	Wed. 8-5	Thurs. 8-6	Fri. 8-7	Mon. 8-10	Tues. 8-11	Wed. 8-12	Thurs. 8-13	Fri. 8-14	Mon. 8-17	Avg.	Max.	Min.	% less than 5.0
Non-intercepted sewer & indus. waste	B-14	46.9	2.2	0.0	1.6	1.4	5.6	1.4	2.8	5.9	5.0	4.6	3.0	5.9	0.0	70
Worcester Sewage Treatment Pl. effl.	B-13	46.0	0.0	0.0	0.0	0.4	0.2	0.0	0.0	2.3	1.0	0.2	0.4	2.3	0.0	100
Felters Co., Millbury sewers, & Snider Packing, dams & rapids	B-12	40.5	7.4	3.9	5.6	4.2	6.2	4.9	2.6	6.5	5.7	6.4	5.4	7.4	2.6	40
Quinsigamond River enters	B-11E	39.7	-	-	-	-	7.5	1.8	6.2	3.0	4.2	5.8	4.8	7.5	1.8	50
Dam at Fisherville	B-11D	39.5	-	-	-	-	7.4	6.7	6.5	6.7	4.2	5.2	6.1	7.4	4.2	17
Pool	B-11C	39.0	-	-	-	-	7.4	1.7	6.5	3.2	1.9	0.9	3.6	7.4	0.9	67
Dam at Farnumsville	B-11B	38.8	-	-	-	-	7.4	4.8	6.4	4.8	2.0	1.9	4.6	7.4	1.9	67
J. J. O'Donnell wastes (Farnumsville)	B-11A	36.9	4.0	4.6	2.2	3.4	5.0	2.0	1.1	2.8	2.0	1.4	2.8	5.0	1.1	90
Dam at Northbridge	B-11	36.8	7.1	7.2	6.4	5.0	7.4	6.4	5.8	6.3	6.7	6.5	6.5	7.4	5.0	0
	B-10C	35.0+	-	-	-	-	2.2	4.4	1.3	5.2	4.4	2.1	3.3	5.2	1.3	83
Dam & Kupfer Co. (Riverdale)	B-10B	35.0-	-	-	-	-	1.3	4.3	2.2	5.0	5.0	3.3	3.5	5.0	1.3	67
	B-10A	34.1	-	-	-	-	2.4	1.6	1.0	4.2	4.0	2.7	2.6	4.2	1.0	100
Northbridge Sewage Treatment Pl. effl.	B-10	31.3	4.9	3.5	5.4	0.9	1.2	0.5	0.8	3.2	0.6	1.1	2.2	5.4	0.5	90
Dam forming Rice City pond Stanley Woolen Co.	B-9	29.9+	7.9	7.4	8.2	6.0	7.3	5.7	6.5	5.8	4.1	6.5	6.5	8.2	4.1	10
Mumford & West rivers enter	B-8A	27.7	-	-	-	-	2.6	2.6	1.4	3.2	2.2	2.9	2.5	3.2	1.4	100
	B-8	24.5	2.3	5.8	5.2	3.3	5.5	3.2	1.6	2.8	1.6	3.4	3.5	5.8	1.6	70
Blackstone Wool & Millville Sew.	B-7A	22.4	7.6	9.2	7.1	5.4	-	3.2	2.2	2.0	1.0	4.11	4.6	9.2	1.0	18
Dam above State line Massachusetts-Rhode Island State line	B-7	22.3	8.3	10.2	8.8	7.9	8.1	8.0	6.8	7.1	6.7	7.6	8.0	10.2	6.7	0
Branch River enters + Blackstone sew. (Rhode Island-Mass. State line)	B-6	21.0	3.6	3.6	3.9	3.3	5.6	3.6	2.3	2.7	5.3	5.0	3.9	5.6	2.3	70
Blackstone Sew. & Indus. Waste (Mass.-Rhode Island State line)	B-5	20.0	3.7	2.3	2.4	4.2	6.4	3.7	3.0	2.0	5.2	4.9	3.8	6.4	2.0	80
Non-intercepted Woonsockrt sew. & ind. waste (+ dams, pools & rapids)	B-4	17.2	9.2	8.3	7.2	9.2	10.3	8.1	8.0	8.0	8.6	8.7	8.5	10.3	7.2	0
Woonsockrt sewage & industrial waste	B-3	14.7	1.5	0.4	0.2	0.8	9.1	0.5	0.1	0.9	2.9	4.7	2.1	9.1	0.1	90
Dam at Manville	B-3A	14.6	5.8	6.3	6.0	6.0	-	6.1	5.6	6.0	7.2	8.1	6.3	8.1	5.8	0
Manville sewage & industrial waste, Albion Sew. (above dam at Ashton)	B-2	11.4+	4.4	2.5	3.2	3.6	10.1	2.9	4.2	2.6	4.6	4.4	4.3	10.1	2.5	90
Ashton & Barkeley sewers	B-1	6.9	3.6	4.4	2.9	3.6	9.8	5.8	4.2	3.9	5.8	5.9	5.0	9.8	2.9	60

Table 24
Dissolved Oxygen
(in mg/1)
Tributaries of Blackstone River
August, 1964 Survey

	Station Number	River Mile	Tues. 8-4	Wed. 8-5	Thurs. 8-6	Fri. 8-7	Mon. 8-10	Tues. 8-11	Wed. 8-12	Thurs. 8-13	Fri. 8-14	Mon. 8-17	Avg.	Max.	Min.	% less than 5.0
Quinsigamond River		B-39.7														
	Q-1	1.8	9.2	11.7	5.4	9.8	13.0	7.4	4.2	7.6	2.6	2.5	7.4	13.0	2.5	30
Mumford River		B-29.5														
	M-4	10.2	-	8.2	8.5	8.1	9.5	8.9	8.3	9.0	9.2	8.4	8.7	9.5	8.1	0
Hayward Woolen Co. (Div. Einiger)																
Hayward Schuster Woolen Mills, Inc.																
	M-3	5.6+	-	10.4	9.1	9.7	11.0	8.8	8.7	9.9	8.8	9.0	9.5	11.0	8.7	0
Whitinsville & Linwood																
	M-2	0.5+	7.4	5.8	7.5	5.9	6.4	8.1	5.3	10.0	9.7	6.6	7.3	10.0	5.3	0
Dam, Uxbridge Sewage & Emile Bernat																
	M-1	0.4	7.5	7.8	8.0	6.6	7.4	7.6	7.0	8.5	11.6	7.1	7.9	11.6	6.6	0
West River		B-28.7														
Waucuntuck Woolen Mill																
	W-1	0.6	7.5	7.8	8.0	6.6	7.4	7.6	7.0	8.5	11.6	7.1	7.9	11.6	6.6	0
Branch River		B-21.9														
	BR-2	2.6	8.1	8.6	9.0	8.0	9.4	9.7	9.2	10.5	9.8	9.6	9.2	10.5	8.0	0
Stamina Mills																
Branch R. Wool Combing Co.																
	BR-1	0.8	4.1	5.2	6.4	6.0	6.1	6.1	5.0	5.7	9.0	4.1	5.8	9.0	4.1	20

Table 25
Dissolved Oxygen
(in mg/1)
Ten Mile River
August, 1964 Survey

	Station Number	River Mile	Tues. 8-4	Wed. 8-5	Thurs. 8-6	Fri. 8-7	Mon. 8-10	Tues. 8-11	Wed. 8-12	Thurs. 8-13	Fri. 8-14	Mon. 8-17	Avg.	Max.	Min.	% less than 5.0
Ten Mile River																
Metal Plating Wastes Whiting Pond	T-9	19.8	7.2	9.1	7.4	9.0	9.0	8.8	7.8	9.6	9.0	9.1	8.6	9.6	7.2	0
Metal Plating Wastes	T-8	16.8	7.9	11.8	6.4	8.3	13.0	6.5	6.6	10.3	9.2	8.8	8.9	13.0	6.4	0
North Attleboro Sewage Treatment Plant	T-7	15.6	0.2	0.9	0.3	0.6	2.3	1.0	0.8	2.4	1.8	3.5	1.2	3.5	0.2	100
Metal Plating Wastes	T-6A	11.6	-	18.9	9.0	18.0	18.4	19.8	18.2	20.0	18.8	21.2	18.0	21.2	9.0	0
Dam & Dodgeville Finishing Co.	T-6	9.3	13.8	11.7	14.2	4.7	19.2	17.2	9.6	20.0	16.6	16.3	14.3	20.0	4.7	10
Hebronville Dam Thompson Chemical Co.	T-5A	8.2	-	13.6	12.4	6.0/11.6	7.4	12.7	10.3	1.1	13.3	10.8	9.9	13.6	1.1	10
Dam at Attleboro Dyeing & Finishing Co. Attleboro Dyeing & Finishing	T-5	8.0	2.6	2.8	3.2	1.5/0.5	3.1	2.7	0.0	3.3	5.4	5.3	2.8	5.4	0.0	82
Attleboro Sewage Treatment Plant Mass.-Rhode Island State Line Seven Mile River enters	T-4	7.4	1.8	2.8	9.6	4.1	7.8	3.0	6.7	5.8	7.2	3.3	5.2	9.6	1.8	50
Rhode Island-Mass. State Line Pawtucket Dyeing & Bleaching Mass.-Rhode Island State Line	T-3	7.0	1.7	0.7	8.4	6.6	5.6	5.5	5.6	4.0	8.8	3.0	5.0	8.8	0.7	40
	T-2A	5.8+	-	-	5.1	6.6	8.1	9.3	5.7	5.8	10.2	7.6	7.3	10.2	5.1	0
Dam at Pawtucket Golf Club East Providence Waterworks Reservoir	T-2	2.5	14.9	9.4	3.6	7.6	8.6	7.9	8.0	8.0	10.3	8.8	8.7	14.9	3.6	10
E. Providence W.W. Reservoir Dam	T-1	0.8	8.8	2.9	7.5	11.0	5.6	6.9	6.6	5.8	10.0	5.8	7.1	11.0	2.9	10
Tributary																
Seven Mile River	S-1	T-7.6 0.6	8.1	8.8	7.3	6.3	-	-	-	-	-	-	7.6	8.8	6.3	0

Table 26
SPECIAL DISSOLVED OXYGEN STUDY
Blackstone River
August 1964 Survey

B-7A (22.4)			B-7 (22.3)			B-7B (22.0)		
Time	Temp. °C	DO mg/1	Time	Temp. °C	DO mg/1	Time	Temp. °C	DO mg/1
TUES. 8-18-64								
8:00a	19.0	1.6	8:05a	18.0	6.6	-	-	-
12:35p	21.0	4.3	12:50p	21.5	8.2	-	-	-
4:00p	21.0	3.8	4:05p	21.0	7.7	3:50p	22.0	8.7
8:55p	19.0	2.9	8:50p	19.0	6.8	8:00p	19.0	7.4
WED. 8-19-64								
12:05a	19.0	2.4	12:15a	19.0	6.7	12:30a	18.5	7.3
4:00a	20.0	3.2	4:10a	19.5	6.8	4:20a	19.0	7.4
8:50a	20.0	5.3	9:00a	20.0	5.0	9:10a	20.0	5.8
1:30p	20.5	5.1	1:20p	20.0	5.4	1:40p	21.0	5.4
4:05p	21.0	4.5	4:10p	21.0	8.1	4:20p	22.0	8.8
7:40p	21.0	3.0	7:45p	21.0	7.0	7:55p	19.0	7.6
THURS. 8-20-64								
3:20p	21.0	3.8	3:30p	21.0	8.3	3:45p	21.0	8.9
11:45p	19.5	2.8	11:55p	19.0	6.5	11:30p	-	7.5
FRI. 8-21-64								
12:40a	19.5	3.4	12:45a	19.5	6.6	12:30a	19.0	7.4
2:25a	19.5	4.0	2:30a	18.0	6.7	3:15a	19.0	7.4
7:00a	19.0	5.4	7:05a	18.0	7.2	7:15a	18.5	7.9
11:15a	20.0	5.3	11:30a	20.0	7.9	11:45a	20.0	8.1
5:55p	20.5	3.8	6:05p	20.0	7.2	6:15p	20.5	7.8
10:10p	20.0	5.6	10:15p	19.5	7.1	10:30p	19.5	7.6
SAT. 8-22-64								
1:45a	20.0	4.4	2:30a	-	6.6	2:15a	-	7.0
6:30a	20.0	3.3	6:30a	19.5	6.4	6:40a	20.0	7.0
NO.		20			20			18
AVG.		3.9			6.8			7.5
MAX.		5.6			8.3			8.8
MIN.		1.6			5.0			5.4

Table 26
SPECIAL DISSOLVED OXYGEN STUDY
Blackstone River
August 1964 Survey
(Cont'd.)

B-6 (21.0)			B-5 (20.0)			B-4 (17.2)		
Time	Temp. °C	DO mg/l	Time	Temp. °C	DO mg/l	Time	Temp. °C	DO mg/l
TUES. 8-18-64								
8:15a	19.0	2.6	8:20a	19.5	2.3	9:10a	20.0	8.3
1:15p	21.0	4.5	1:30p	21.0	6.1	1:40p	22.0	9.1
4:15p	21.5	4.6	4:25p	21.0	6.2	5:40p	20.5	8.1
8:15p	20.0	3.6	8:25p	20.0	4.8	8:50p	20.5	6.8
WED. 8-19-64								
12:45a	20.0	1.1	12:55a	19.5	2.5	1:15a	20.0	6.9
4:35a	19.0	2.0	4:45a	20.0	1.5	5:00a	19.0	7.1
9:25a	19.5	2.6	9:40a	20.5	1.7	10:00a	20.5	7.8
1:55p	22.0	3.6	2:05p	20.0	5.2	2:20p	22.0	8.0
4:30p	22.5	4.0	4:40p	21.0	5.3	5:00p	22.0	7.7
8:00p	21.0	3.3	8:15p	21.0	4.0	8:45p	21.0	6.5
NO.		10			10			10
AVG.		3.2			4.0			7.6
MAX.		4.6			6.2			9.1
MIN.		1.1			1.5			6.5

B-3 (14.7)			B-3A (14.6)		
Time	Temp. °C	DO mg/l	Time	Temp. °C	DO mg/l
TUES. 8-18-64					
9:25a	20.0	2.1	9:40a	20.0	7.8
1:55p	23.0	7.1	2:15p	22.5	6.4
5:25p	21.0	0.8	5:20p	21.0	6.0
9:00p	20.0	0.1	9:05p	19.5	5.7
WED. 8-19-64					
1:30a	20.0	0.0	1:45a	20.0	5.7
5:15a	19.5	0.0	5:25a	19.0	5.8
10:15a	21.0	0.2	10:10a	21.0	0.9
2:30p	22.0	0.5	2:40p	22.0	2.3
5:20p	23.0	2.3	5:30p	22.0	4.9
8:55p	20.5	0.0	9:00p	20.5	5.6
NO.		10			10
AVG.		1.3			5.1
MAX.		7.1			7.8
MIN.		0.0			0.9

Table 26
SPECIAL DISSOLVED OXYGEN STUDY
Blackstone River
August 1964 Survey
(Cont'd.)

BR-2 (2.6)			BR-1 (0.8)		
Time	Temp. °C	DO mg/l	Time	Temp. °C	DO mg/l
TUES. 8-18-64					
8:45a	20.5	8.7	9:00a	20.0	4.6
12:15p	23.0	9.8	12:25p	19.0	4.8
4:45p	24.0	10.1	4:30p	22.0	5.0
8:35p	21.0	9.2	8:45p	21.0	2.8
WED. 8-19-64					
2:00a	21.0	8.6	2:10a	20.0	4.1
5:40a	20.5	8.3	5:55a	20.0	5.3
8:30a	21.0	8.7	8:40a	20.0	4.7
1:00p	23.0	9.6	1:10p	25.0	4.9
4:50p	22.0	9.6	5:00p	23.0	5.5
8:25p	21.0	9.6	8:35p	21.5	4.1
NO.		10			10
AVG.		9.2			4.6
MAX.		10.1			5.5
MIN.		8.3			2.8

Table 27
DISSOLVED OXYGEN (D.O. in mg/l)
COMPARISON OF SPECIAL & ROUTINE SURVEY DATA
Blackstone & Branch Rivers
August 1964 Survey

Station No.	River Mile	Special	Avg. Routine	Wt.Avg.[1] S & R	MAX. Special	MAX. Routine	MIN. Special	MIN. Routine
BLACKSTONE RIVER								
B-7A	22.4	3.9	4.6	4.1	5.6	9.2	1.6	1.0
B-7	22.3	6.8	8.0	7.3	8.3	10.2	5.0	6.7
B-7B	22.0	7.5	-	-	8.8	-	5.4	-
B-6	21.0	3.2	3.9	3.6	4.6	5.6	1.1	2.3
B-5	20.0	4.0	3.8	3.9	6.2	6.4	1.5	2.0
B-4	17.2	7.6	8.5	8.0	9.1	10.3	6.5	7.2
B-3	14.7	1.3	1.3	1.3	7.1	9.1	0.0	0.1
B-3A	14.6	5,1	6.3	5.7	7.8	8.1	0.9	5.8
BRANCH RIVER								
BR-2	2.6	9.2	9.2	9.2	10.1	10.5	8.3	8.0
BR-1	0.8	4.6	5.8	5.2	5.5	9.0	2.8	4.1

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[1] Average is weighted according to number of samples in each series.

Table 28
SPECIAL D.O. STUDY
Ten Mile River
August 1964 Survey

T-6A (11.6)			T-6 (9.3)			T-5A (8.2)		
Time	Temp.	D.O.	Time	Temp.	D.O.	Time	Temp.	D.O.
THURS. 8-20			THURS. 8-20			THURS. 8-20		
8:45a	20	5.90	8:40a	20	13.38	8:55a	19	6.22
12:10p	22	20.95	12:00N	22	16.38	12:25p	22	12.16
4:15p	22	16.95	4:00p	22	16.97	4:30p	24	14.79
8:45p	21	15.00	8:30p	20	6.25	9:05p	21	6.30
11:50p	20	13.45	11:45p	20	14.15	FRI. 8-21 12:05a	19	3.55
FRI. 8-21			FRI. 8-21					
4:35a	20	13.30	4:25a	20	12.70	4:45a	20	5.65
8:15a	20	11.70	8:25a	20	13.60	8:35a	20	6.00
1:20p	24	15.20	1:35p	22	19.52	1:50p	22	14.66
3:55p	22	22.14	3:45p	24	16.43	4:05p	24	13.51
8:10p	22	21.00	8:00p	24	16.10	8:20p	22	8.40
11:30p	22	4.55	11:20p	22	3.00	11:40p	22	2.40
SAT. 8-22			SAT. 8-22			SAT. 8-22		
3:50a	22	18.55	3:40a	22	3.75	3:55a	21	5.80

	T-6A (11.6)	T-6 (9.3)	T-5A (8.2)
NO.	12	12	12
AVG.	14.9	12.7	8.3
MAX.	22.1	19.5	14.8
MIN.	4.6	3.0	2.4

Table 28
SPECIAL D.O. STUDY
Ten Mile River
August 1964 Survey
(Cont'd.)

T-5 (8.0)			T-4 (7.4)			T-3 (7.0)		
Time	Temp.	D.O.	Time	Temp.	D.O.	Time	Temp.	D.O.
THURS. 8-20			THURS. 8-20			THURS. 8-20		
9:00a	19	5.62	9:10a	18	3.05	9:05a	18	1.80
12:40p	22	11.39	1:05p	22	6.99	12:55p	22	7.13
4:45p	22	4.30	5:00p	21	5.66	5:10p	22	5.69
9:20p	22	2.45	9:45p	20	1.60	9:35p	22	0.0
FRI. 8-21			FRI. 8-21			FRI. 8-21		
12:10a	20	2.05	12:30a	20	0.0	12:20a	20	0.0
4:55a	18	1.75	5:10a	18	0.0	5:05a	18	0.0
9:00a	20	3.27	9:30a	19	2.08	9:15a	19	0.90
2:10p	22	8.14	2:30p	24	10.01	2:25p	23	-
4:15p	22	6.65	4:35p	22	6.93	4:30p	23	6.95
8:30p	22	1.55	8:50p	21	3.55	8:45p	22	0.0
			SAT. 8-22			SAT. 8-22		
11:50p	21	0.55	12:05a	20	0.0	11:55p	21	0.0
SAT. 8-22								
4:05a	21	1.55	4:20a	20	0.0	4:15a	20	0.0
NO.		12			12			12
AVG.		4.1			3.3			2.0
MAX.		11.4			10.0			7.1
MIN.		0.6			0.0			0.0

Table 28
SPECIAL D.O. STUDY
Ten Mile River
August 1964 Survey
(Cont'd.)

T-2A (5.8^+)			T-2 (2.5)		
Time	Temp.	D.O.	Time	Temp.	D.O.
THURS. 8-20			THURS. 8-20		
9:20a	19	5.36	9:30a	21	11.33
1:20p	22	9.22	1:40p	22	9.40
5:25p	22	6.38	-	-	-
10:00p	20	6.75	10:30p	20	14.45
FRI. 8-21			FRI. 8-21		
12:40a	20	6.40	12:50a	20	7.20
5:20a	19	5.10	5:35a	20	7.00
9:45a	20	6.28	10:00a	22	11.21
2:55p	24	10.19	3:15p	24	17.63
4:50p	24	10.66	5:05p	23	16.04
9:00p	22	7.45	9:20p	22	15.05
SAT. 8-22			SAT. 8-22		
12:15a	22	2.20	12:30a	22	3.65
4:30a	21	4.05	4:45a	21	10.1
NO.		12			11
AVG.		6.7			11.2
MAX.		10.7			16.0
MIN.		2.2			3.6

Table 29
DISSOLVED OXYGEN
COMPARISON OF SPECIAL & ROUTINE SURVEY DATA
Ten Mile River
August 1964 Survey

				Wt.Avg.	MAX.		MIN.	
STA.	R.M.	Special	Routine	S & R	Special	Routine	Special	Routine
T-6A	11.6	14.9	18.0	16.3	22.1	21.2	4.6	9.0
T-6	9.3	12.7	14.3	13.4	19.5	20.0	3.0	4.7
T-5A	8.2	8.3	9.9	9.0	14.8	13.6	2.4	1.1
T-5	8.0	4.1	2.8	3.5	11.4	5.4	0.6	0.0
T-4	7.4	3.3	5.2	4.2	10.0	9.6	0.0	1.8
T-3	7.0	2.0	5.0	3.4	7.1	8.8	0.0	0.7
T-2A	5.8+	6.7	7.3	6.9	10.7	10.2	2.2	5.1
T-2	2.5	11.2	8.7	10.0	16.0	14.9	3.6	3.6

Table 30
Temperature
(Values in °C)
Blackstone River
August, 1964 Survey

Station Number	River Mile	Tues. 8-4	Wed. 8-5	Thurs. 8-6	Fri. 8-7	Mon. 8-10	Tues. 8-11	Wed. 8-12	Thurs. 8-13	Fri. 8-14	Mon. 8-17	No. of Samples	Avg.	Max.	Min.
Blackstone River															
B-14	46.9	20	22	22	23	22	22	22	25	20	20	10	22	25	20
B-13	46.0	20	24	22	23	21	22	22	24	20	20	10	22	24	20
B-12	40.5	20	23	21	22	21	21	22	22	18	20	10	21	23	18
Quinsigamond River enters															
B-11E	39.7	-	-	-	-	21	21	22	21	21	20	6	21	22	20
B-11D	39.5	-	-	-	-	22	20	22	21	21	20	6	21	22	20
B-11C	39.0	-	-	-	-	21	21	22	22	20	20	6	21	22	20
B-11B	38.8	-	-	-	-	21	21	22	22	20	20	6	21	22	20
B-11A	36.9	20	23	22	22	22	20	22	-	20	20	9	21	23	20
B-11	36.8	20	23	22	23	20	21	21	-	20	20	9	21	23	20
B-10C	35.0+	-	-	-	-	20	21	21	23	21	20	6	21	23	20
B-10B	35.0-	-	-	-	-	20	21	21	23	21	20	6	21	23	20
B-10A	34.1	-	-	-	-	20	20	21	23	21	20	6	21	23	20
B-10	31.3	22	22	22	21	19	20	20	22	18	19	10	21	22	18
B-9	29.9+	23	21	22	21	19	20	20	22	19	20	10	21	23	19
Mumford & West rivers enter															
B-8A	27.7	-	-	-	-	20	20	20	22	20	20	6	20	22	20
B-8	24.5	19	21	21	21	20	20	20	22	19	20	10	20	22	19
B-7A	22.4	20	20	20	21	-	21	20	20	20	20	9	20	21	20
Mass. Rhode Island State line															
B-7	22.3	20	21	21	22	20	20	20	20	20	20	10	20	22	20
Branch River enters Rhode Island-Mass. State line															
B-6	21.0	20	20	20	21	20	20	21	20	20	18	10	20	21	18
Mass.-Rhode Island State line															
B-5	20.0	20	20	20	20	20	20	20	20	19	19	10	20	20	19
B-4	17.2	23	22	20	22	22	20	21	20	20	20	10	21	23	20
B-3	14.7	23	22	20	22	22	21/20	22	20	20	20	11	21	23	20
B-3A	14.6	22	22	21	23	-	22	22	21	20	20	9	21	23	20
B-2	11.4+	23	21	21	23	22	20	22	20	21	20	10	21	23	20
B-1	6.9	22	22	21	22	22	21	22	21	20	20	10	21	22	20

Table 31
Temperature
(Values in °C)
Blackstone River Tributaries
August, 1964 Survey

Station Number	River Mile	Tues. 8-4	Wed. 8-5	Thurs. 8-6	Fri. 8-7	Mon. 8-10	Tues. 8-11	Wed. 8-12	Thurs. 8-13	Fri. 8-14	Mon. 8-17	No. of Samples	Avg.	Max.	Min.
Quinsigamond River	B-39.7														
Q-1	1.8	20	23	20	22	21	20	21	20	16	18	10	20	23	16
Mumford River	B-29.5														
M-4	10.2	-	20	22	20	21	20	20	22	20	18	9	20	22	18
M-3	5.6	-	22	22	22	24	22	22	22	21	21	9	22	24	21
M-2	0.5	23	21	22	21	20	21	22	22	22	20	10	22	23	20
M-1	0.4	22	22	23	22	20	21	22	22	20	20	10	21	23	20
West River	B-28.7														
W-1	0.6	21	21	20	20	18	19	20	20	18	20	10	20	21	18
Branch River	B-21.9														
BR-2	2.6	22	22	22	22	23	22	22	23	21	21	10	22	23	21
BR-1	0.8	22	24	23	20	22	22	22	24	20	21	10	22	24	20

Table 32
Temperature
(Values in °C)
Ten Mile River & Tributary
August, 1964 Survey

Station Number	River Mile	Tues. 8-4	Wed. 8-5	Thurs. 8-6	Fri. 8-7	Mon. 8-10	Tues. 8-11	Wed. 8-12	Thurs. 8-13	Fri. 8-14	Mon. 8-17	No. of Samples	Avg.	Max.	Min.
Whiting Pond															
T-9	19.8	20	22	21	24	22	20	21	22	20	21	10	21	24	20
T-8	16.8	16	21	18	20	21	18	21	22	17	19	10	19	22	17
T-7	15.6	17	21	18	18	22	18	20	24	17	18	10	19	24	17
T-6A	11.6	-	22	22	22	22	21	21	22	20	20	9	21	22	20
T-6	9.3	20	21	22	22	21	20	21	24	21	20	10	21	24	20
T-5A	8.2	-	22	22	20/25	21	20	21	21	23	20	10	22	25	20
T-5	8.0	20	22	20	20/24	19	20	22	21	22	19	11	21	24	19
Mass.-Rhode Island State line Seven Mile River enters															
T-4	7.4	23	19	22	24	20	20	22	21	21	18	10	21	24	18
Rhode Island-Mass. State line Mass.-Rhode Island State line															
(St.line) T-3	7.0	25	20	22	24	20	20	22	21	22	18	10	21	24	18
T-2A	5.8+	-	-	24	25	19	21	22	20	22	19	8	22	25	19
T-2	2.5	25	22	24	22	21	20	22	21	22	20	10	22	25	20
T-1	0.8	23	20	22	24	20	20	22	20	21	19	10	21	24	19
Tributary															*
Seven Mile River	T-7.6														
S-1	0.6	17	20	18	16	-	-	-	-	-	-	4	18	20	16

Table 33
Hydrogen Ion Concentration - pH
Blackstone & Ten Mile Rivers
August, 1964 Survey

Station No.	River Mile	8-4		8-5		8-6		8-7		8-10		8-11		8-12		8-13		8-14		8-17		FIELD - LAB Avg.		Max.		Min.	
		Fld.	Lab.	Fld.	Lab.	Fld.	Lab.	Fld.	Lab.	Fld.	Lab.	Fld.	Lab.	Fld.	Lab.	Fld.	Lab.	Fld.	Lab.	Fld.	Lab.	Fld.	Lab.	Fld.	Lab.	Fld.	Lab.
Blackstone River																											
B-14	46.9	6.2	6.3	7.4	3.7	7.2	6.1	6.0	4.2	6.8	7.7	7.2	-	5.8	6.4	6.4	-	5.2	4.3	5.2	-	6.3	5.5	7.4	7.7	5.2	3.7
B-13	46.0	6.6	6.7	7.2	6.8	7.2	6.3	6.0	3.5	6.8	7.1	6.2	6.7	6.6	7.0	5.2	5.0	6.0	6.6	6.4	6.8	6.4	6.2	7.2	7.1	5.2	3.5
B-12	40.5	7.0	7.1	7.2	6.3	7.2	6.7	6.0	6.0	6.6	7.2	6.4	6.8	6.2	6.1	6.6	6.9	6.2	6.5	6.8	7.2	6.6	6.7	7.2	7.2	6.0	6.0
Quinsigamond River enters																											
B-11A	36.9	6.8	-	-	-	-	-	-	-	6.6	-	6.4	-	6.6	-	-	-	6.4	-	6.4	-	6.5	-	6.8	-	6.4	-
B-11	36.8	7.0	7.2	7.2	7.2	7.2	7.0	6.6	6.9	6.8	6.9	6.6	6.9	6.8	7.1	6.4	-	6.6	6.9	6.6	7.0	6.9	7.0	7.2	7.2	6.4	6.9
B-10	31.3	6.8	7.1	6.6	6.8	7.2	7.0	6.2	6.5	6.9	6.7	7.0	-	7.1	6.8	6.6	-	6.3	6.8	6.3	-	6.7	6.8	7.2	7.1	6.2	6.5
B-9	29.9+	7.0	7.2	7.2	6.7	6.6	6.9	6.3	6.4	6.6	6.7	6.9	-	6.9	6.8	6.4	-	6.4	6.6	6.2	-	6.6	6.8	7.2	7.2	6.2	6.4
Mumford River enters																											
West River enters																											
B-8A	27.7	-	-	-	-	-	-	-	-	6.3	6.5	7.1	-	6.9	6.6	6.3	-	6.4	6.6	6.2	-	6.5	6.6	7.1	6.6	6.2	6.5
B-8	24.5	6.2	6.5	6.1	6.5	6.3	6.4	6.3	6.3	6.2	6.2	7.1	-	7.0	6.4	6.3	-	6.5	6.5	6.3	-	6.4	6.4	7.0	6.5	6.1	6.2
B-7A	22.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.9	-	6.7	-	-	-	6.8	-	6.9	-	6.7	-
B-7	22.3	6.4	6.8	6.2	6.6	7.1	6.6	7.1	6.2	6.4	6.5	7.3	6.2	7.0	6.3	7.0	6.3	6.5	6.7	6.8	-	6.8	6.5	7.1	6.8	6.2	6.2
Branch River enters																											
B-6	21.0	6.5	7.0	6.5	7.0	6.4	6.9	6.4	6.7	6.6	6.6	7.0	6.6	6.9	6.7	6.3	6.8	6.4	6.8	7.1	6.8	6.6	6.8	7.1	7.0	6.3	6.6
B-5	20.0	6.5	7.0	6.6	6.8	6.5	7.2	6.4	6.8	6.5	6.8	6.9	6.8	6.8	6.6	6.3	6.9	6.4	6.7	7.1	6.8	6.6	6.8	7.1	7.2	6.4	6.6
B-4	17.2	7.2	7.3	6.7	7.0	6.7	7.0	7.1	7.2	7.3	7.2	7.1	-	6.7	7.2	6.7	-	6.5	7.0	6.7	-	6.9	7.1	7.3	7.3	6.5	7.0
B-3	14.7	7.2	6.9	7.3	6.9	6.5	6.9	7.1	6.8	6.9	7.1	6.8/6.3	-	6.6	7.3	6.4	-	6.3	6.7	6.4	-	6.7	6.9	7.3	7.3	6.3	6.7
B-3A	14.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.5	-	6.7	-	6.6	-	6.7	-	6.5	-
B-2	11.4+	7.3	6.8	7.2	6.8	6.5	7.0	6.9	6.8	7.1	7.2	6.6	-	6.6	7.0	6.6	-	6.5	6.8	6.7	-	6.8	6.9	7.3	7.2	6.5	6.8
B-1	6.9	7.2	6.7	7.2	7.0	6.4	6.8	6.6	6.8	7.0	7.0	6.7	-	6.7	6.9	6.5	-	6.6	7.1	6.5	-	6.7	6.9	7.2	7.1	6.4	6.7
Blackstone Tributaries																											
Quinsigamond River B-39.7																											
Q-1	1.8	7.4	7.5	8.8	8.0	7.2	7.2	7.4	7.4	6.8	-	6.8	-	6.6	-	6.8	-	6.6	-	6.4	-	7.1	7.5	8.8	8.0	6.4	7.2
Mumford River B-29.5																											
M-4	10.2	-	-	6.2	6.5	6.4	6.7	6.2	6.2	6.0	-	6.0	-	6.0	-	6.0	-	5.8	-	5.8	-	6.0	6.5	6.4	6.7	5.8	6.2
M-3	5.6+	-	-	7.2	6.9	6.2	6.5	6.4	6.1	6.4	-	6.0	-	5.8	-	6.0	-	5.8	-	5.8	-	6.2	6.5	7.2	6.9	5.8	6.1
M-2	0.5+	6.6	7.0	6.6	6.7	7.1	6.8	7.1	6.7	6.4	6.8	6.6	-	6.2	-	6.6	-	6.8	-	6.4	-	6.6	6.8	7.1	7.0	6.2	6.7
M-1	0.4	6.6	7.1	6.4	6.8	7.1	6.8	7.3	6.7	6.2	6.9	6.4	6.6	6.4	6.6	6.6	6.7	6.6	7.0	6.2	7.0	6.6	6.8	7.3	7.1	6.2	6.6
West River B-28.7																											
W-1	0.6	6.6	7.1	7.2	6.8	6.4	6.8	7.1	6.7	6.0	-	6.4	-	6.4	-	6.2	-	6.2	-	6.4	-	6.5	6.8	7.2	7.1	6.0	6.7
Branch River B-21.9																											
BR-2	2.6	6.9	7.3	7.0	7.1	6.9	7.2	6.9	6.8	7.3	7.1	7.3	7.4	7.2	7.6	7.4	7.6	7.4	8.3	7.1	8.6	7.1	7.5	7.4	8.6	6.9	6.8
BR-1	0.8	7.1	7.8	7.3	7.9	7.2	7.4	6.9	7.3	7.4	7.8	7.2	7.3	7.4	8.0	7.4	8.0	7.1	6.8	7.5	8.2	7.2	7.6	7.5	8.2	6.9	6.8
Ten Mile River																											
T-9	19.8	7.5	7.6	7.5	7.5	7.1	7.3	7.5	7.0	7.5	-	7.3	7.7	7.1	-	8.0	7.6	7.5	-	7.3	-	7.4	7.4	8.0	7.6	7.1	7.0
T-8	16.8	7.1	7.4	7.1	7.3	6.9	7.1	-	7.0	7.8	-	6.7	7.2	6.9	-	7.3	7.1	6.3	-	7.1	7.2	7.0	7.2	7.8	7.4	6.3	7.0
T-7	15.6	6.7	7.2	6.9	7.0	6.7	7.0	6.5	6.8	7.7	-	6.3	7.2	6.5	-	6.7	7.1	6.2	-	6.1	6.8	6.6	7.0	7.7	7.2	6.1	6.8
T-6	9.3	8.4	8.9	7.4	7.4	8.5	8.7	6.7	8.5	8.9	-	8.3	9.3	7.2	-	9.1	9.2	8.7	-	8.7	8.7	8.2	8.7	9.1	9.3	6.7	8.5
T-5A	8.2	-	-	-	-	-	-	-	-	7.1	7.1	8.3	8.2	6.4	6.7	7.1	7.3	8.9	8.3	7.3	7.5	7.5	7.5	8.9	8.3	6.4	6.7
T-5	8.0	6.7	7.2	6.7	6.8	6.9	6.9	6.7	6.9	6.6	7.5	6.9	7.0	6.5	6.8	6.7	7.0	6.8	6.9	6.6	7.0	6.7	7.0	6.9	7.5	6.5	6.8
Seven Mile River enters																											
T-4	7.4	6.9	7.2	6.9	7.0	7.1	7.1	6.9	7.2	7.2	7.0	6.9	7.0	7.1	7.0	6.5	7.0	6.7	6.8	6.6	7.0	6.9	7.0	7.2	7.2	6.5	6.8
T-3	7.0	7.1	7.3	8.1	8.4	7.1	7.2	-	7.2	6.9	6.9	6.8	7.0	6.9	7.1	6.7	7.0	6.9	7.0	6.7	7.0	7.0	7.2	8.1	8.4	6.7	6.9
T-2	2.5	8.9	9.5	7.1	7.0	-	9.2	7.5	7.3	7.7	-	7.3	7.4	7.5	-	7.5	7.5	8.6	-	8.3	7.8	7.8	8.0	8.9	9.5	7.3	7.0
T-1	0.8	6.9	7.4	6.5	7.1	7.1	7.5	7.7	7.6	7.0	-	7.0	-	7.1	-	6.9	-	7.3	-	6.9	-	7.0	7.4	7.7	7.6	6.5	7.1
Ten Mile Tributary																											
Seven Mile River T-7.6																											
S-1	0.6	6.5	6.7	6.9	6.8	6.5	7.0	6.3	6.9	-	-	-	-	-	-	-	-	-	-	-	-	6.6	6.8	6.9	7.0	6.3	6.7

Table 34
Metals
Ten Mile River
(Values in mg/l)
August, 1964

	Station	River Mile	Tues. 8-4	Wed. 8-5	Thurs. 8-6	Fri. 8-7	Mon. 8-10	Tues. 8-11	Wed. 8-12	No. of Samples	Avg.	Max.	Min.
Copper	T-9	T-19.8	0.24	0.16	0.22	0.26	0.24	0.29	0.24	7	0.24	0.29	0.16
	T-7	15.6	0.30	0.14	0.06	0.24	0.26	0.32	0.28	7	0.23	0.32	0.06
	T-6	9.3	0.50	0.56	0.66	0.55	0.64	0.70	0.58	7	0.60	0.70	0.50
	T-4	7.4	0.40	0.41	0.52	0.28	0.50	0.52	-	6	0.44	0.52	0.28
	T-2	2.5	0.61	0.38	0.33	0.44	0.48	0.29	0.34	7	0.41	0.61	0.29
Cadmium	T-9	19.8	0.00	0.00	0.00	0.00	0.04	0.00	0.00	7	0.01	0.04	0.00
	T-7	15.6	0.00	0.11	0.05	0.00	0.00	0.00	0.00	7	0.02	0.11	0.00
	T-6	9.3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7	0.00	0.00	0.00
	T-4	7.4	0.00	0.00	0.00	0.05	0.00	0.00	0.00	6	0.01	0.05	0.00
	T-2	2.5	0.00	0.00	0.00	0.00	0.00	Tr.	0.00	7	0.00	Tr.	0.00
Nickel	T-9	19.8	0.04	0.00	0.01	Tr.	0.01	0.04	0.00	7	0.01	0.04	0.00
	T-7	15.6	0.10	0.08	0.14	0.14	0.08	0.18	0.18	7	0.13	0.18	0.08
	T-6	9.3	0.51	0.57	0.47	0.45	1.29	1.28	0.39	7	0.71	1.29	0.39
	T-4	7.4	0.23	0.24	0.25	0.28	0.37	0.42		6	0.30	0.42	0.23
	T-2	2.5	0.10	0.06	0.05	0.07	0.08	0.09	0.09	7	0.08	0.10	0.05
Zinc	T-9	19.8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7	0.00	0.00	0.00
	T-7	15.6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7	0.00	0.00	0.00
	T-6	9.3	0.50	0.55	0.00	0.48	0.00	0.33	0.00	7	0.26	0.55	0.00
	T-4	7.4	0.00	0.00	0.00	0.00	0.00	0.00	-	6	0.00	0.00	0.00
	T-2	2.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7	0.00	0.00	0.00
Chromium	T-9	19.8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7	0.00	0.00	0.00
	T-7	15.6	0.00	0.07	0.00	0.00	0.00	0.00	0.00	7	0.01	0.07	0.00
	T-6	9.3	0.00	0.00	0.00	0.00	0.05	0.00	0.00	7	0.01	0.05	0.00
	T-4	7.4	0.00	0.12	0.07	0.00	0.00	0.00	-	6	0.03	0.12	0.00
	T-2	2.5	0.00	0.00	0.00	0.00	0.00	0.00	0.04	7	0.00	0.04	0.00

Table 35
A. B. S.
Blackstone River & Ten Mile River
(Values in mg/1)
August, 1964 Survey

Station	River Mile	Tues. 8-4	Wed. 8-5	Thurs 8-6	Fri. 8-7	Mon. 8-10	Tues. 8-11	Wed. 8-12	Thurs. 8-13	No. of Samples	Avg.	Max.	Min.
Blackstone River													
B-14	46.9	-	-	-	-	0.36	-	0.40	-	2	0.38	0.40	0.36
B-13	46.0	1.00	0.84	0.90	1.00	0.80	>2.0	1.00	0.50	8	>1.00	>2.0	0.50
B-12	40.5	-	-	-	-	-	-	0.96	0.60	2	0.78	0.96	0.60
B-11C	39.0	-	-	-	-	-	-	1.15	-	1	1.15	1.15	1.15
B-11	36.8	0.65	0.76	1.14	1.00	1.25	1.06	1.30	-	7	1.02	1.30	0.65
B-10	31.3	-	-	-	-	-	-	0.95	-	1	0.95	0.95	0.95
B-9	29.9+	0.83	0.80	0.75	0.80	0.75	-	0.85	-	6	0.80	0.85	0.75
B-8	24.5	-	-	-	-	-	-	0.62	-	1	0.62	0.62	0.62
B-7	22.3	0.67	0.46	0.48	0.68	0.68	0.72	0.70	0.68	8	0.63	0.72	0.46
B-6	21.0	-	-	-	-	-	0.58	0.48	0.52	3	0.53	0.58	0.48
B-5	20.0	-	-	-	-	0.57	-	0.50	0.51	3	0.53	0.57	0.50
B-4	17.2	-	-	-	-	-	-	0.33	-	1	0.33	0.33	0.33
B-3	14.7	0.87	0.63	0.70	0.70	0.58	-	0.54	-	6	0.67	0.87	0.54
B-2	11.4	-	-	-	-	-	-	0.70	-	1	0.70	0.70	0.70
B-1	6.9	-	-	-	-	0.62	-	0.55	-	2	0.58	0.62	0.55
Tributaries of Blackstone River													
BR-1	21.9-0.8	0.44	0.27	0.20	0.28	0.37	0.22	0.18	0.38	8	0.29	0.44	0.18
BR-2	21.9-2.6	-	-	-	-	0.14	0.07	0.10	0.15	4	0.11	0.15	0.07
M-1	29.5-0.4	0.55	0.28	0.43	0.35	0.46	0.58	0.70	-	7	0.48	0.70	0.28
Sewage Treatment Effluent													
Worcester Sewage Treatment Plant		-	-	-	-	-	-	1.00	-	1	1.00	1.00	1.00
Ten Mile River													
T-9	19.0	-	-	-	-	-	0.10	-	0.08	2	0.09	0.10	0.08
T-8	16.8	-	-	-	-	-	0.20	-	0.20	2	0.20	0.20	0.20
T-7	15.6	-	-	-	-	-	-	-	1.40	1	1.40	1.40	1.40
T-6	9.3	-	-	-	-	-	-	0.35	0.32	2	0.34	0.35	0.32
T-5	8.0	-	-	-	-	-	0.43	-	0.30	2	0.36	0.43	0.30
T-5A	8.3	-	-	-	-	-	0.50	0.34	0.50	3	0.45	0.50	0.34
T-4	7.4	-	-	-	-	-	0.64	0.18	-	2	0.41	0.64	0.18
T-3	7.0	-	-	-	-	-	0.79	0.55	0.50	3	0.61	0.79	0.50
T-2	2.5	-	-	-	-	-	-	-	0.25	1	0.25	0.25	0.25
Sewage Treatment Effluent													
Attleboro Sewage Treatment Plant		-	-	-	-	-	> 2.0	-	> 2.0	2	> 2.00	> 2.00	> 2.00
North Attleboro Sewage Treatment Plant		-	-	-	-	-	> 2.0	-	> 2.0	2	> 2.00	> 2.00	> 2.00

Table 36
Nitrogen Series
(Values in mg/1)
Blackstone River
August, 1964 Survey

Station Number	River Mile	Tues. 8-4	Wed. 8-5	Thurs. 8-6	Fri. 8-7	Mon. 8-10	Tues. 8-11	Wed. 8-12	Thurs. 8-13	Fri. 8-14	Mon. 8-17	No. of Samples	Avg.	Max.	Min.
Nitrates (NO_3^- in mg/1)															
B-13	46.0	0.65	1.95	0.23	0.62	2.52	1.43	1.27	1.22	1.80	2.32	10	1.40	2.52	0.23
B-12	40.5	-	-	-	-	-	-	-	2.16	1.81	1.06	3	1.68	2.16	1.06
B-11	36.8	2.06	0.92	0.70	0.77	1.12	0.97	0.66	-	1.20	0.76	9	1.02	2.06	0.66
B-9	30.0	2.03	2.06	1.76	2.00	2.17	-	1.79	-	1.77	2.04	8	1.95	2.17	1.76
B-7	22.3	2.07	1.93	1.96	2.20	2.41	2.55	2.36	2.15	-	2.40	9	2.22	2.55	1.93
B-3	14.7	1.20	0.98	0.68	0.46	1.12	-	0.63	-	1.66	1.74	8	1.06	1.74	0.46
BR-1	21.9-0.8	0.35	0.41	0.33	0.21	0.50	0.44	-	0.43	-	0.59	8	0.41	0.59	0.21
M-1	29.5-0.4	0.54	0.49	0.21	0.20	0.18	0.16	0.14	-	0.21	0.13	9	0.25	0.54	0.13
Nitrites (NO_2^- in mg/1)															
B-13	46.0	0.004	0.005	0.002	0.004	0.006	0.004	0.003	0.004			8	0.004	0.005	0.002
B-12	40.5	-	-	-	-	-	-	-	0.002			1	0.002	0.002	0.002
B-11	36.8	0.003	0.004	0.002	0.004	0.004	0.003	0.002	-			7	0.003	0.004	0.002
B-9	30.0	0.002	0.004	0.001	0.004	0.003	-	0.002	-			6	0.003	0.004	0.001
B-7	22.3	0.001	0.004	0.001	0.003	0.003	0.003	0.002	0.001			8	0.002	0.004	0.001
B-3	14.7	0.004	0.020	0.007	0.004	0.003	-	0.007	-			6	0.008	0.020	0.003
Blackstone River Tributaries															
Branch River	21.9														
BR-1	0.8	0.001	0.003	0.001	0.001	0.001	0.001	-	0.001			7	0.001	0.003	0.001
[illegible]ford River	29.5														
[illegible]-1	0.4	0.001	0.001	0.003	0.003	0.003	0.001	0.001	-			7	0 002	0.003	0.001
Ammonia (NH_3 in mg/1)															
B-13	46 0	2.2	3.6	0.6	1.2	5.0	0.1	4.3	1.3			8	2.3	5.0	0.1
B-12	40.5	-	-	-	-	-	-	-	0.7			1	0.7	0.7	0.7
B-11	36.8	0.1	2.6	1.4	4.3	3.0	2.5	2.6	-			7	2.4	4.3	0.1
B-9	30.0	2.9	1.6	0.6	1.4	2.0	-	2.5	-			6	1.8	2.9	0.6
B-7	22.3	0.3	0.2	0.1	0.0	0.6	0.2	0.4	0.4			8	0.3	0.6	0.0
B-3	14.7	1.0	0.8	0.4	0.5	0.2	-	0.7	-			6	0.6	1.0	0.2
Blackstone Tributaries															
Branch River	21.9														
BR-1	0.8	1.1	2.9	1.9	0.4	4.6	0.5	-	3.6			7	2.1	4.6	0.4
Mumford River	29.5														
[illegible]	[illegible]	0.7	[illegible]	[illegible]	0	0.4	[illegible]	[illegible]	[illegible]			7	0.5	[illegible]	[illegible]

Table 37
Sampling Times
Blackstone River
August 1964 Survey

	Station Number	River Mile	Tues. 8-4	Wed. 8-5	Thurs. 8-6	Fri. 8-7	Mon. 8-10	Tues. 8-11	Wed. 8-12	Thurs. 8-13	Fri. 8-14	Mon. 8-17
Blackstone River												
	B-14	46.9	9:20A	1:30P	8:40A	11:55A	2:20P	11:25A	12:45P	2:00P	8:40A	9:00A
	B-13	46.0	9:40A	1:45P	8:55A	11:40A	2:30P	11:40A	12:05P	1:45P	8:10A	8:50A
	B-12	40.5	11:50A	2:30P	9:40A	10:50A	3:10P	12:35P	1:15P	10:45A	9:10A	8:15A
Quinsigamond River Enters												
	B-11E	39.7	-	-	-	-	3:30P	1:00P	1:35P	11:10A	11:30A	7:55A
	B-11D	39.5	-	-	-	-	3:35P	12:50P	1:25P	11:00A	11:35A	8:05A
	B-11C	38.9	-	-	-	-	3:40P	1:10P	1:45P	11:20A	9:30A	10:55A
	B-11B	38.8	-	-	-	-	3:45P	1:20P	1:50P	11:15A	9:35A	11:05A
	B-11A	37.0	11:10A	2:55P	9:55A	10:40A	3:55P	1:30P	2:00P	-	9:50A	11:20A
	B-11	36.8	11:15A	3:05P	10:10A	10:30A	10:25A	1:40P	11:25A	11:50A	10:00A	11:30A
	B-10C	35.0$^+$	-	-	-	-	10:40A	1:50P	11:10A	3:45P	1:15P	11:40A
	B-10B	35.0$^-$	-	-	-	-	10:45A	1:55P	11:15A	3:35P	1:10P	11:45A
	B-10A	34.1	-	-	-	-	11:05A	2:15P	11:25A	3:25P	12:55P	11:55A
	B-10	31.3	4:05P	11:00A	11:55A	9:00A	10:00A	4:20P	9:55A	1:45P	8:10A	12:55P
	B-9	30.0	2:15P	9:45A	2:00P	9:40A	10:30A	4:05P	10:15A	2:10P	8:30A	12:35P

Table 37
Sampling Times
Blackstone River
August 1964 Survey

	Station Number	River Mile	Tues. 8-4	Wed. 8-5	Thurs. 8-6	Fri. 8-7	Mon. 8-10	Tues. 8-11	Wed. 8-12	Thurs. 8-13	Fri. 8-14	Mon. 8-17
Mumford & West Rivers Enter												
	B-8A	27.7	-	-	-	-	10:45A	3:50P	10:30A	2:35P	9:00A	12:15P
	B-8	24.5	9:00A	11:35A	11:20A	10:15A	11:00A	3:35P	10:45A	2:55P	9:25A	12:00N
	B-7A	22.4	9:25A	10:55A	10:50A	10:35A	-	3:10P	11:00A	11:25A	9:45A	10:25A
	B-7	22.3	9:40A	11:05A	11:00A	10:45A	11:25A	3:20P	11:10A	11:40A	10:00A	10:35A
Branch River Enters												
	B-6	21.0	10:05A	10:40A	10:30A	11:05A	11:50A	11:25A	11:25A	11:10A	10:15A	10:05A
	B-5	20.0	10:30A	10:20A	10:20A	11:20A	12:05P	11:10A	11:40A	10:55A	10:30A	9:50A
	B-4	17.2	12:30P	9:30A	8:05A	11:55A	2:00P	10:55A	3:15P	10:40A	12:10P	9:30A
	B-3	14.7	12:55P	9:00A	8:30A	12:15P	2:20P	2:40P 10:35A	3:35P	10:15A	12:30P	9:00A
	B-3A	14.6	1:15P	9:15A	8:40A	12:30P	-	2:30P	3:50P	10:25A	12:45P	9:15A
	B-2	11.4	1:45P	8:00A	9:00A	12:50P	2:45P	10:15A	4:10P	9:55A	1:00P	8:35A
	B-1	6.9	3:45P	8:25A	9:20A	1:15P	3:10P	9:55A	4:35P	9:30A	1:20P	8:15A

Table 38
Sampling Times
Blackstone River Tributaries
August 1964 Survey

	Station Number	River Mile	Tues. 8-4	Wed. 8-5	Thurs. 8-6	Fri. 8-7	Mon. 8-10	Tues. 8-11	Wed. 8-12	Thurs. 8-13	Fri. 8-14	Mon. 8-17
Quinsigamond River		39.7										
	Q-1	39.7-1.0	10:20A	12:15P	9:20A	11:10A	2:55P	12:20P	1:05P	10:30A	9:00A	8:30A
Mumford River		29.5										
	M-4	29.5-10.2	-	8:15A	12:30P	8:15A	1:50P	10:35A	9:30A	2:20P	12:00N	7:15A
	M-3	29.5- 5.6	-	8:45A	1:00P	8:35A	1:30P	10:20A	9:45A	2:35P	12:25P	7:30A
	M-2	29.5- 0.5	3:35P	10:15A	12:35P	9:00A	11:50A	3:00P	10:10A	2:55P	2:10P	12:35P
	M-1	29.5- 0.4	3:20P	10:00A	1:10P	9:15A	11:40A	2:50P	10:25A	3:00P	2:00P	12:30P
West River		28.7										
	W-1	28.7- 0.6	5:00P	9:25A	1:45P	9:30A	11:30A	2:30P	10:40A	9:55A	1:45P	12:15P
Branch River		21.9										
	BR-2	21.9- 2.6	11:35A	12:00N	11:40A	8:30A	12:40P	4:50P	2:40P	3:10P	11:30A	1:25P
	BR-1	21.9- 0.8	11:15A	12:25P	12:00N	8:15A	12:25P	5:05P	2:25P	3:25P	11:50A	1:40P

Table 39
Sampling Times
Ten Mile River & Tributaries
August 1964 Survey

	Station Number	River Mile	Tues. 8-4	Wed. 8-5	Thurs. 8-6	Fri. 8-7	Mon. 8-10	Tues. 8-11	Wed. 8-12	Thurs. 8-13	Fri. 8-14	Mon. 8-17
Whiting Pond												
	T-9	19.8	8:50A	11:45A	8:45A	10:45A	3:20P	10:00A	9:45A	3:50P	10:20A	10:20A
	T-8	16.8	9:30A	12:15P	9:10A	10:25A	3:00P	10:45A	10:15A	3:40P	10:45A	10:40A
	T-7	15.6	10:00A	12:35P	9:20A	10:10A	2:45P	11:00A	10:35A	3:20P	11:00A	11:05A
	T-6A	11.6	-	1:00P	9:50A	9:55A	2:20P	12:00N	10:50A	3:00P	11:35A	1:50P
	T-6	9.3	10:45A	1:15P	10:00A	9:40A	2:00P	12:10P	11:00A	2:50P	11:45A	1:30P
	T-5A	8.3	-	2:00P	11:00A	9:20A 4:15P	10:30A	3:05P	5:30P	11:55A	5:10P	3:25P
	T-5	8.0	11:15A	1:45P	10:25A	9:00A 4:00P	10:00A	2:55P	5:40P	12:10P	5:25P	3:35P
Seven Mile River Enters		7.6										
	T-4	7.4	4:50P	9:35A	12:40P	4:45P	11:45A	3:40P	5:00P	11:20A	4:50P	2:20P
	T-3	7.0	4:35P	9:25A	12:50P	4:55P	12:00N	3:30P	5:15P	11:40A	5:00P	2:05P
	T-2A	5.8	-	-	2:05P	5:50P	11:30A	3:55P	4:45P	10:35A	4:35P	2:35P
	T-2	2.5	3:10P	9:00A	1:40P	5:30P	11:10A	4:15P	4:30P	11:00A	4:00P	3:00P
	T-1	0.6	4:05P	8:30A	1:15P	5:15P	10:50A	4:30P	4:20P	10:20A	4:15P	2:50P
Tributaries												
Seven Mile River		7.6										
	S-1	7.6-0.6	11:45A	4:15P	11:05A	8:40A	-	-	-	-	-	-

Table 40
River Discharge
During August, 1964 Survey
Blackstone River & Tributaries

	Station Number	River Mile	Flow cfs
	B-14	46.9	40.8
Worcester sewage			34.0
	B-13	46.0	74.8
	B-12	40.5	79.2
Quinsigamond River enters			2.4 (1)
	B-11C	38.9	82.9
	B-11A	37.0	84.4
	B-11	36.8	84.4
U.S.G.S. Gage	-	36.7	84.6 (1)
	B-10	31.3	85.1
	B-9	30.0	85.2
Mumford River enters			20.0
West River enters			3.6 (1)
	B-8A	27.7	109.0
	B-8	24.5	109.3
	B-7A	22.4	109.5
	B-7	22.3	109.5
Branch River enters			21.3 (1)
	B-6	21.0	130.9
	B-5	20.0	131.0
U.S.G.S. Gage	-	17.6	131.4 (1)
	B-4	17.2	131.5
Woonsocket Sewage			7.7
	B-3	14.7	139.4
	B-3A	14.6	139.4
	B-2	11.4	139.7
	B-1	6.9	140.1

(1) Average of U.S.G.S. provisional discharge data from 8/2/64 through 8/21/64.

Note: Other values are estimates; interpolated from U.S.G.S. discharge data, sewage flows, and occasional PHS field measurements.

Table 41
River Discharge
During August, 1964 Survey
Ten Mile River

	Station Number	River Mile	Flow cfs
	T-9	19.8	0.1
	T-8	16.8	2.0
No. Attleboro sewage enters	-	15.9	2.3
	T-7	15.6	5.1
Bungay River enters	-	14.8	3.0
	T-6A	11.6	10.8
	T-6	9.3	12.3
	T-5A	8.3	
	T-5	8.0	13.2
Attleboro sewage enters	-	7.8	2.8
Seven Mile River enters	-	7.6	3.2
	T-4	7.4	19.6
	T-3	7.0	19.9
E. Providence Waterworks intake	-		-3.2
	T-2	2.5	19.7
	T-1	0.8	20.8

Note: Discharge values are estimates based on a single PHS field measurement at each of the following stations: T-9, T-7, T-6A, T-5, and T-3. Discharges remained relatively stable during survey period.

Table 42
New England Interstate Water Pollution Control Commission
Classification and Standards of Quality for Interstate Waters
(As revised and adopted October 1, 1959)

	CLASS A	CLASS B	CLASS C	CLASS D
SUITABILITY FOR USE				
	Suitable for any water use. Character uniformly excellent.	Suitable for bathing and recreation, irrigation and agricultural uses; good fish habitat; good aesthetic value. Acceptable for public water supply with filtration and disinfection.	Suitable for recreational boating, irrigation of crops not used for consumption without cooking; habitat for wildlife and common food and game fishes indigenous to the region; industrial cooling and most industrial process uses.	Suitable for transportation of sewage and industrial wastes without nuisance, and for power, navigation and certain industrial uses.
STANDARDS OF QUALITY				
Dissolved oxygen	Not less than 75% sat.	Not less than 75% sat.	Not less than 5 p.p.m.	Present at all times
Oil and grease	None	No appreciable amount.	Not objectionable	Not objectionable
Odor, scum, floating solids, or debris	None	None	None	Not objectionable
Sludge deposits	None	None	None	Not objectionable
Color and turbidity	None	Not objectionable	Not objectionable	Not objectionable
Phenols and other taste producing substances	None	None	None	
Substances potentially toxic	None	None	Not in toxic concentrations or combinations	Not in toxic concentrations or combinations
Free acids or alkalies	None	None	None	Not in objectionable amounts
Radioactivity	Within limits approved by the appropriate State agency with consideration of possible adverse effects in downstream waters from discharge of radioactive wastes; limits in a particular watershed to be resolved when necessary after consultation between States involved.			
Coliform bacteria	* Within limits approved by State Department of Health for uses involved.	Bacterial content of bathing waters shall meet limits approved by State Department of Health and acceptability will depend on sanitary survey.		

* Sea waters used for taking of market shellfish shall not have a median coliform content in excess of 70 per 100 ml.

NOTE: Waters falling below these descriptions are considered as unsatisfactory and as Class E.
These standards do not apply to conditions brought about by natural causes.
For purpose of distinction as to use, waters used or proposed for public water supply shall be so designated.

Table 43

Historical Discharge Records
Discharges in cfs
Blackstone River & Tributaries

Blackstone River at Northbridge, Mass.

Water Year	Yearly Mean	August Mean
1951	267	92.8
1952	347	200
1953	324	103
1954	325	174
1955	408	1195
1956	400	83.1
1957	189	61.2
1958	320	150
1959	299	171
1960	371	161
1961	288	105
1962	250	107
1963	274	92.0
1964	-	84.6 (1)

24-yr. Average (1939-1963) = 246 cfs.
Maximum Discharge = 16,900 cfs (Aug. 20, 1955).
Minimum Discharge = 2 cfs (Aug. 29, 1941, Sept. 5, 1942, Aug. 28, 1957).

Blackstone River at Woonsocket, R. I.

Water Year	Yearly Mean	August Mean
1951	761	321
1952	933	270
1953	808	158
1954	816	255
1955	1090	2704
1956	1158	169
1957	531	121
1958	878	262
1959	768	310
1960	969	289
1961	852	204
1962	772	202
1963	778	158
1964	-	131 (1)

34-yr. Average (1929-1963) = 731 cfs.
Maximum Discharge = 32,900 cfs (Aug. 19, 1955).
Minimum Discharge = 21 cfs (Aug. 11, 1934).

Table 43 (cont.)

Historical Discharge Records
Discharge in cfs
Blackstone River Tributaries

	Water Year	Yearly Mean	August Mean
Branch River at Forestdale, R. I.			
	1951	171	61.1
	1952	205	44.8
	1953	178	31.4
	1954	182	47.9
	1955	224	372
	1956	250	32.3
	1957	122	21.4
	1958	193	46.3
	1959	164	49.4
	1960	200	47.7
	1961	185	37.5
	1962	159	34.8
	1963	149	23.4
	1964	-	21.3 (1)

23-yr. Average (1940-1963) = 165 cfs.
Maximum Discharge = 4240 cfs (Aug. 19, 1955).
Minimum Discharge _ 5.2 cfs (Oct. 7, 1948).

Quinsigamond River at North Grafton, Mass.			
	1951	43.6	11.4
	1952	60.2	30.1
	1953	51.3	5.5
	1954	49.7	24.2
	1955	65.5	169
	1956	68.4	6.5
	1957	25.8	1.9
	1958	54.6	19.1
	1959	47.9	23.5
	1960	56.7	25.2
	1961	44.4	15.4
	1962	41.1	8.7
	1963	43.3	5.0
	1964	-	2.4 (1)

24-yr. Average (1939-1963) = 43 cfs.
Maximum Discharge = 820 cfs. (Aug. 20, 1955).
Minimum Discharge = 0.3 cfs (Oct. 14-17, 1942).

(1) Average flow for survey period of Aug. 2, 1964 through Aug. 21, 1964.